PERFUMES, COSMETICS AND SOAPS

With Special Reference to

SYNTHETICS

By

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PH.C., F.R.P.S.

Volume Two

BEING A TREATISE ON THE PRODUCTION, MANUFACTURE AND APPLICATION OF PERFUMES OF ALL TYPES

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AUTHOR'S PREFACE TO THE SIXTH EDITION

SINCE the publication of the last edition of this work, a considerable amount of research has been devoted by chemists in France and Switzerland to the constitution of some of the flower oils.

I have included the more important results in the respective flower monographs, and this information should be useful to perfumers duplicating the various blossom odours.

I have reviewed the formulæ in the light of this work and made adjustments where necessary.

W. A. Poucher

40 PICCADILLY,
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PERFUMES

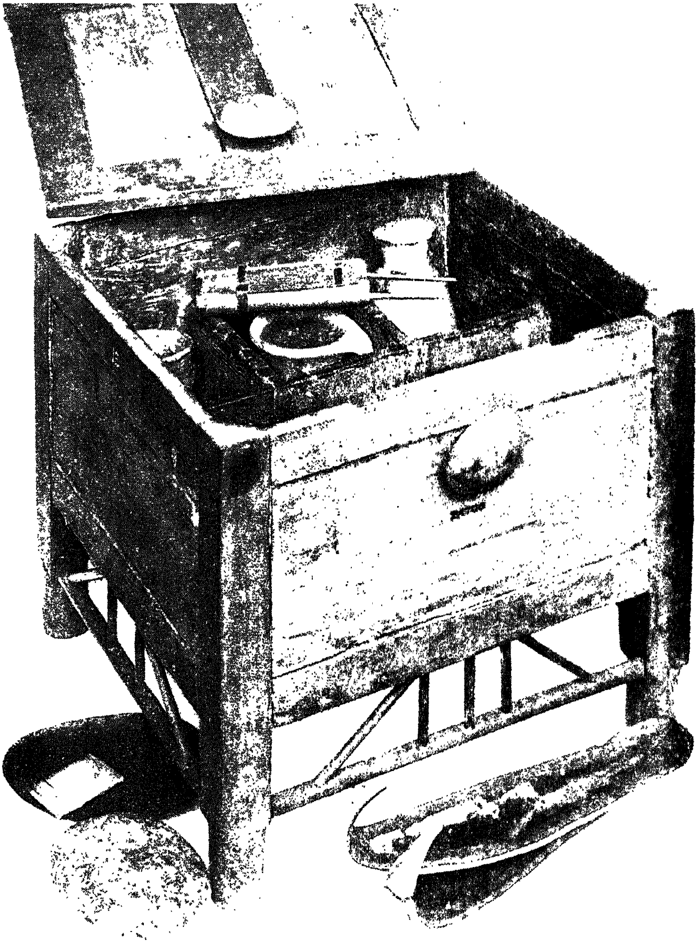


FIG. 1.—Wooden Toilet Box.

[*To face page* 3.

This belonged to Tutu, the wife of the Scribe Ani, and was found in a tomb at Thebes, XVIIIth Dynasty, about 1400 B.C. The divisions are ornamented with redwood and ebony. The contents are:—

1. Terra-cotta vase, containing unguent.
2. Two alabaster vases, containing unguents.
3. Pumice stone, for smoothing the skin.
4. Double stibium tube, bound with leather, and provided with two pencils, the one wood and the other ivory. One tube contained powder to be smeared on the eyes during the inundation, and the other a medicinal paste for use in hot weather when the air was filled with dust and sand.
5. An ivory comb with carved back.
6. A bronze "shell" for mixing unguents.
7. A pair of gazelle skin sandals.
8. Three red cushions for the elbows.

[*British Museum, Exhibit No.* 24708.

CHAPTER I.

HISTORICAL SKETCH.

If it were possible to delve into the past at a sufficiently remote period, it would probably be found that the romance of perfumery had its beginning with the Atlantians who flourished at a period conjectured to antedate the Christian Era by about 23,000 years. Cosmetics appear to have been known to this second sub-race, who are believed to have employed a form of petroleum as one of their principal toilet accessories.

The Chinese may have been the forerunners of Western civilisation, and although they are believed to have conquered the aboriginal tribes who inhabited that part of Asia sometime during the third Millennium B.C., little is known concerning their history before 800 B.C.

It is therefore necessary to turn to Egypt for the earliest records of perfumery. The first Dynasty is known as the Thinite and its first ruler was King Menes. He is said to have conquered Lower Egypt, founded Memphis, and built the temple of Ptah. His tomb was opened in 1897. Other tombs of the eight kings of the first Dynasty and of the nine kings of the second are at Abydos, and all show traces of the Egyptian habit of burying needments and luxuries for the dead. The first Dynasty is variously placed at 3500 to 5000 years B.C. and several examples of art at that period still exist. For instance, in the British Museum, there are many beautiful unguent vases carved in alabaster which authorities have dated about 3500 B.C. Other specimens of interest to the perfumer are :—

Mirrors used in the sixth Dynasty—2800 B.C.

Kohl vases (in glass) and stibium pencils used in the eighteenth Dynasty—1500 B.C.

Papyrus showing men and women having lumps of nard fixed on top of the head—1500 B.C.

The opening by Mr. Howard Carter of the tomb of Tutankhamen who ruled about 1350 B.C. has brought to light many excellent specimens of the early perfumer's art. According to eyewitnesses, the unguent vases, exquisitely executed in alabaster, contained quantities of aromatics which were still elusively fragrant. This cosmetic was examined in 1926 by Chapman and Plenderleith. The odour emitted has been compared variously with cocoa-nut oil, broom, and valerian. The chemical evidence supported the view that the fat was of animal character and accounted for 90 per cent. of the whole. The remaining 10 per cent. appeared to consist of some resin or balsam.

Cosmetics, manicure instruments, and razors thousands of years old are stated to be among the latest objects forwarded from the tomb of Queen Hetepheres to the Cairo Museum. Hetepheres was the mother of Khufu, or Cheops, the Pharaoh of the Fourth Dynasty (about 3500 B.C.?) to whom is attributed the Great Pyramid at Giza.

The Egyptian Office of Works communiqué says that the articles include thirty alabaster vessels, a large copper ewer with its copper basin and toilet box, three gold cups and implements and tools of gold, copper, and flint. Among the alabaster vessels are two of unique form. The toilet box of wood is a reconstruction of an old box which was found in fragments on the floor, but the contents are the original contents, eight small alabaster jars and a copper spoon. Seven of the jars contained the seven traditional perfumed ointments of the Egyptians, and the eighth contained kohl. Six of the lids of these jars have been preserved and inscribed with the names of the contents, while a single hieroglyphic sign on the rim of each jar indicates the connection between each lid and its respective jar. The contents of the jars consist of dry fibrous remains, probably vegetable, which have been removed for examination and analysis.

Objects in solid gold include a small drinking cup with a re-curved rim and spout, two small cups, two razors, three rectangular knives, a manicure implement with a sharp end for cleaning the nails and a rounded end for pressing down the skin at the base of the nails. The copper implements consist of five razors, which, with the two gold razors, make a set of seven, and four rectangular knives which, with the three gold knives, make another set of seven. With these is a set of extraordinary flint implements, which seem to be older prototypes of the metal implements, thirteen oval flints or flint razors, and nine rectangular flint knives. There is also a very fine, small copper needle.

On other monuments and tombs in Egypt there is still ample evidence of their great esteem for aromatics. For instance, on the large granite tablet inserted in the breast of the sphinx, King Thothmes IV. (about 1600 B.C.) is portrayed making an offering of incense and of fragrant oil or unguent.

Perfumes were used for three quite distinct purposes by the Egyptians :—

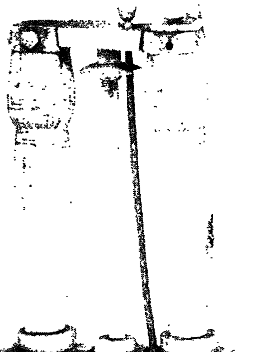
1. As offerings to their deities.
2. For æsthetic purposes during their lives.
3. As the principal agents for embalming their dead.

It was customary for the priests to burn incense before the gods in the temples, and this incense probably consisted of aromatic gums, resins, and oleo-resins mixed with perfumed woods. These substances were made into small pieces and were volatilised by being thrown into the glowing censers. In some cases these operations were performed several times a day. At Heliopolis—where the sun worshippers foregathered—resins were burned at dawn, myrrh at noon, and kaphi at sunset. This substance *kaphi* is believed to have been a mixture of several aromatic ingredients, of the nature of which there is no record. At the fete of the God, Isis, it was customary to sacrifice an ox. The odour of burnt flesh was, however, so obnoxious, that the worshippers found it necessary to fill up his interior with aromatic gums and oils, which made these sacred observances more amenable. In religious processions there was always a lavish display of perfumes, while no king was ever crowned without being anointed with fragrant oils by the priests. At this period it is probable that the priests made most of the perfumes, fragrant oils, and unguents; they were therefore the perfumers of their time and their pursuit was considered a mysterious and much-esteemed art. The containers were beautiful *objets d'Art* and were executed in all kinds of valuable material. Ivory and alabaster were the principal substances used, while frequently carved wood, onyx, and porphyry were fashioned into pots and vases.

The ancient Egyptians were probably the inventors of the bath, which habit, in later years, was treated on a much more elaborate scale by the Greeks and Romans. This form of ablution was probably necessitated by the terrific heat of that country and it was followed by the liberal application of perfumed oils and unguents. Doubtless these were employed to give the skin more elasticity as well as to impart a balmy and pleasing effect to these æsthetic people. This practice, though not so extensive, is still applied by the Eastern nations in order to prevent an undue drying of the epidermis and the irritation that would follow.

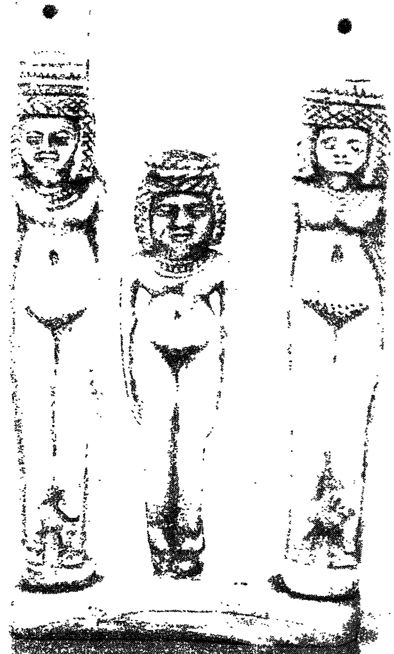
Sesame oil appears to have been one of the most favoured vehicles for the aromatics, although both almond and olive oils were undoubtedly used. Some of the odorous constituents were grown in Egypt while the greater proportion were most probably imported from Arabia. Amongst the former may be mentioned thyme and origanum, together with a substance called *balanos*, which appears to have been extracted from the shells of some unidentified fruit, while of the latter myrrh, olibanum, and spikenard were of great importance.

The process of embalming the dead was so important during the Egyptian era that sections of the towns were peopled by men who made this their profession. Accord-



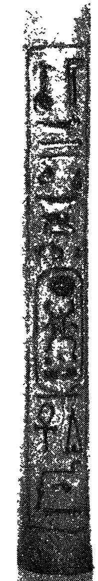
22839

68 [22839]
DOUBLE KOHL-POT
IN THE SHAPE OF
TWO PAPYRUS-ROD COLUMNS
WITH A TRIANGULAR LILY COLUMN BETWEEN
[illegible]
Ivory [illegible Dynasty]



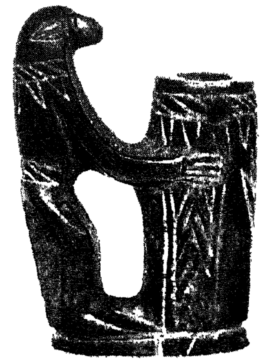
70 [30464]
DOUBLE KOHL-TUBE WITH CARVED RELIEF FIGURES OF GODDESSES WITH LIONS; THE RECEPTACLE FOR THE KOHL-STICK, IN THE MIDDLE, IS IN THE FORM OF A SIMILAR FIGURE IN THE ROUND.
Ivory [Ethiopian style; 8th-6th cent. B.C.]

52 [illegible]
[illegible]



[illegible] [27376]
FAIENCE KOHL-TUBE
INSCRIBED WITH THE NAME OF
TUTANKHAMEN
[XVIIIth Dynasty, [illegible]]

72 [2606]
QUADRUPLE KOHL-POT.
WITH THE NAME OF THE SCRIBE
I'AHMASE
Glazed steatite [XVIIIth Dynasty c. 1600 B.C.]



[26355]
KOHL-POT
HELD BY AN APE
Blackened steatite [XIIth Dynasty]

[22824]
STIBIUM-POT
HELD BY A SQUATTING APE
Pottery [XIIth Dynasty ?]

ing to Herodotus, who travelled much in Egypt, it was customary to remove the brains and intestines, replacing the former with drugs and the latter with aromatic gums such as myrrh and frankincense. The body was then covered with native sodium sesquicarbonate (natron) for about two months (seventy days) which dried up the epidermis and the underlying tissues. Linen was soaked with gums and the body wrapped up in this prepared material. The whole was then enclosed in a timber case fashioned somewhat in the human form and subsequently painted in bright colours. This was the process adopted by the élite of Egyptian society and was by no means an inexpensive matter. The common people who could not afford this process had their dead preserved by the injection of oil or by merely the soda bath ; the corpse being subsequently enclosed as above indicated.

The use of cosmetics had not escaped the attention of the Egyptian ladies, who enhanced their personal beauty by the employment of somewhat crude paints. These practices reached their zenith in the time of Cleopatra. It seems probable, from discoveries in Egyptian tombs, that the highest degree of cosmetic art was attained in the embellishment of their eyes. This effect was produced by painting the under side of the eye green and the lid, lashes, and eyebrows black by the application of *kohl*—the product being made chiefly from galena and applied with an ivory or wooden stick. Imitations of these prettily worked implements, together with the kohl boxes, are sold to-day in Egypt. Combs and mirrors were also used by the Egyptian ladies. According to A. Lucas,[1] out of 61 samples of ancient Egyptian kohl analysed, 40 contained approximately 65 per cent of galena, a lead ore. Two of these contained a trace of antimony sulphide and 4 some carbon . . . of the remaining 21 samples, 2 consisted of lead carbonate, 1 black oxide of copper, 5 brown ochre, 1 magnetic oxide of iron, 6 manganese oxide, 1 antimony

[1] "Ancient Egyptian Materials and Industries."

sulphide, 4 malachite, a copper ore, and 1 chrysocolla, a greenish-blue copper ore.

Lip-salves, probably dating back to about 3500 B.C., have recently been brought to light by Dr. A. Kenneth Graham during excavations at Ur. This gentleman is of the opinion that they were used by Queen Shubad, and were found to contain large quantities of lead.

The use of henna was (and still is) much in favour and was applied to the finger-nails and palms of the hands. Good and well-preserved specimens can be seen to-day in the British Museum.

At the banquets and entertainments given by the wealthy Egyptians, it was customary to have a lavish display of flowers. This consisted in strewing the rooms and tables with lotus and saffron flowers. A peculiar custom, related by Herodotus, consisted in the introduction to these banquets of a mummy. A man would enter when the revel was at its height and shout, "Look at this. Drink and make merry, for so you will be after your death."

The first chapters of the Bible are believed to refer to about 4004 B.C., and in the description of the Garden of Eden[1] there is a reference to *bdellium*. It has been impossible to determine the constitution of this substance from this particular mention, but it has been presumed to be even a mineral by reason of its association with onyx stone. It was not until 2126 B.C. that Abram journeyed into Egypt,[2] and as there is only the above-mentioned reference to aromatic substances before this date, it must be presumed that the Hebrews obtained their knowledge of the uses of perfumes from the Egyptians. The earliest specific reference to commerce in aromatic substances is in 1729 B.C. when the Ishmeelites came from Gilead with their camels bearing spicery and balm and myrrh.[3] Exactly what is meant by *spicery* has not been definitely proved, but according to different commentators, it may be considered to be either storax or tragacanth. The constitution and source of *balm* is equally indefinite. It is considered by

[1] Gen. ii. 12. [2] Gen. xii. 14. [3] Gen. xxxvii. 25.

some botanists to be mastic because this plant is prolific in the rocky country of Gilead. Others are of the opinion that it was derived from a species of the N.O. Simarubaceæ. By pounding and boiling the fruit of this plant an oil was obtained which was known as "Balm of Gilead."

In the Book of Exodus[1] the references to aromatic substances become specific and are numerous.[2] The Shittim wood mentioned in the first verse was probably obtained from a species of *Acacia*. The spices referred to in verses 23, 24, and 25 (containing the instructions for the preparation of the oil of holy ointment) are not grown in Egypt, and it must be assumed therefore that they were brought from the east by the traders. The *stacte* and *onycha* mentioned in verse 34 are supposed to have been styrax and labdanum respectively. Other references to aromatic substances are to be found in Exodus xxxv., xxxvii., xl., Numbers xvi., 2 Kings ix., 2 Chronicles ix., xxvi., Esther ii., Psalms xlv., cxxxiii., Proverbs vii., xxvii., Isaiah xxxix., lvii., St. Mark xiv., St. John xix. The Song of Solomon is dated about 1014 B.C. and it contains numerous references to perfumes. Most of these are mentioned elsewhere in the Scriptures, with the exception of *camphire*.[3] This is considered by botanists to be henna, or at least a closely allied species of *Lawsonia*, possibly *L. alba*.

Cosmetics were evidently used by the Jewish women, for it is written that "when Jehu was come to Jezreel, Jezebel heard of it; and *she painted her face*, and tired her head, and looked out at a window."[4] This is explained more clearly in the following passage, "Thou didst wash thyself, *paintedst thy eyes*,[5] and deckedst thyself with ornaments."[6]

While briefly referring to perfumery in connection with religion and the Scriptures, it seems desirable that something should be said about the Koran, although it was written

[1] Chapter xxx. [2] Verses 1, 7, 23, 24, 25, 34, 35, 36, 37, 38.
[3] Song of Solomon i. 14, iv. 13.
[4] 2 Kings ix. 30. [5] Probably with kohl.
[6] Ezek. xxiii. 40, and see also Jer. iv. 30.

several centuries later—about A.D. 600. Mahomet wrote this work in a very disconnected manner, and the chapters are called Suras. In these Suras appear frequent references to aromatic substances, and there is no doubt that the Arabs' love of perfumes helped them to appreciate the teachings of this religious work to a much greater degree. Musk was, of course, one of their most esteemed perfumes. In Sura lxxxiii.[1] it is mentioned as follows :—

"The Seal of musk. For this let those pant who pant for bliss."

In Sura lvi. Mahomet describes some of the joys which the faithful shall experience in the Gardens of delight. He says :—

"Of a *rare* creation have we created the Houris, and we have made them even virgins."

In Rodwell's translation the word "rare" is in italics, but no explanation is given of its meaning. According to Rimmel[2] this is probably *pure musk*.

In Sura lv. "these damsels with retiring glances" are described as having eyes like "*Hyacinths* and pearls."

In Suras lii. and lvi. appear the following passages :—

"On couches ranged in rows shall they recline ; and to the damsels with large dark eyes will we wed them."

"And theirs shall be the Houris, with large dark eyes, like pearls hidden in their shells."

These two passages would probably indicate the application of kohl which was, and still is, so much used by the ladies of the East.

The founder of one of the earliest Persian religions was Zoroaster, who flourished about 1000 B.C. Zoroastrianism is to-day represented in India by the Parsees. This prophet substituted fire worship for idolatry. Incense was burnt continuously, and to ensure against the fire burning out the priests were changed five times daily.

These ancient Asiatic nations had a great predilection for cosmetics, and this was by no means confined to the fair

[1] Rodwell's translation. J. M. Dent & Sons, Ltd.

[2] "The Book of Perfumes," 126. Chapman & Hall (1865).

FIG. 4.—The Hair Pins and Stibium Pencils are about 2000 B.C., and the Ear Studs about 1400 B.C.

FIG. 5.—Unguent Vases: No. 49347 is of alabaster with fayence lid in blue (1200 B.C.); the next one on the right is of haematite mounted with gold (2000 B.C.).

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sex. It is probable that Babylon and Nineveh (corresponding with the modern Paris and London?) were the chief centres where this art was practised. Herodotus, who is generally regarded as the father of history, lived from 490-420 B.C., and although he travelled widely in Egypt and Greece, spent much of his time in Babylon. He says that the Babylonians were great consumers of aromatics and perfumed their bodies with the most expensive odours. A peculiar practice then in vogue was the use of pumice-stone, rubbed on the skin to make it smooth. Red and white paint for the face was common, the former being vermilion and the latter white lead. Egyptian kohl was also a favourite, named at that time stibium, which was probably a sulphide of antimony. This, however, according to A. Lucas is a mistaken idea, possibly arising from the Roman use in eye cosmetics and eye medicines of an antimony compound called by Pliny *stimmi* and *stibi*. It was applied to the lids and corners of the eyes to make them more brilliantly lustrous.

The Greeks held the use of perfumes in high esteem, and the art was practised largely by women. As was usual with all their pursuits, they had some mythological conception concerning the origin of perfumes. Venus was believed to have been the first user of aromatics, and man's knowledge of them was attributed to an indiscretion of one of her nymphs by the name of Ænone. Paris thus conveyed to Helen of Troy the secret which enabled her to acquire and retain that marvellous beauty for which she was so famed. Homer frequently refers to perfumes in his "Iliad" and "Odyssey." In the former he thus describes the toilet of Juno:—

> Here first she bathes, and round her body pours
> Soft oils of fragrance and ambrosial showers.

Theophrastus was probably the earliest Greek writer on the subject of perfumery. He was born in 370 B.C. and lived to the age of 85. His principal work was on botany and is characterised by a peculiar and yet remarkable classification of plants. His minor works on perfumery and the weather are equally interesting reading. For instance, he speaks of a compounded perfume (as distinct from a flower perfume) as one that is artificially and deliberately produced; thus the method of the makers of perfumed powders is to mix solid with solid, that of those who compound unguents is to mix liquid with liquid: but the third method which is commonest, is that of the perfumer, who mixes *solid with liquid.*

Concerning fixation, Theophrastus says:[1] "Now the composition and preparation of perfumes aim entirely, one may say, at making odours last. That is why men make oil the vehicle of them, since it keeps a very long time and also is most convenient for use."

"They use spices in the making of all perfumes; some to thicken[2] the oil, some in order to impart their odour. The less powerful spices are used for the thickening, and then at a later stage they put in the one whose odour they wish to secure. For that which is put in last always dominates, even if it is in small quantity; thus if a pound of myrrh is put into a half-pint of oil, and at a later stage a third of an ounce of cinnamon is added, this small amount dominates."

Theophrastus thus describes the raw materials from which perfumes were prepared:—

"Perfumes are compounded from various parts of the plants: flowers, leaves, twigs, root, wood, fruit, and gum; and in most cases the perfume is made from a mixture of several parts. Rose and gilliflower perfumes are made from the flowers: so also is the perfume called *Susinon*, this too being made from flowers, namely lilies: also the perfumes named from bergamot mint and tufted thyme, *kypros*, and also the saffron perfume. The crocus which produces this is best in Aegina and Cilicia. Instances of those made from the leaves are the perfumes called from myrtle and drop-

[1] Hort's translation in the Loeb classical library. William Heinemann.

[2] This probably means to reduce its volatility and so make it more persistent.

wort: this grows in Cyprus on the hills and is very fragrant: that which grows in Hellas yields no perfume, being scentless.

"From roots are made the perfumes named from iris, spikenard, and sweet marjoram, an ingredient in which is *koston*;[1] for it is the root to which this perfume is applied. The Eretrian unguent is made from the root of *kypeiron*, which is obtained from Cyclades as well as from Enboea. From wood is made what is called 'palm perfume': for they put in what is called the 'spathe,' having first dried it. From fruits are made the quince perfume, the myrtle and the bay. The 'Egyptian' is made from several ingredients, including cinnamon and myrrh."

A compound perfume mentioned by this ancient author is one called *Megaleion*, named presumably after its inventor. It contains burnt resin, oil of *balanos*, cassia, cinnamon, and myrrh. This is alleged to have been a very difficult perfume to make!

Concerning the habits of the Greek perfumers Theophrastus says: "Perfumers seek upper rooms which do not face the sun, but are shaded as much as possible. For the sun or a hot place deprives the perfumes of their odour, and in general makes them lose their character more than cold treatment."

Other classical literature of the Greeks gives a fairly comprehensive insight into the use they made of cosmetics. In addition to the above-mentioned articles, they coloured their cheeks and lips with a root called *polderos*, which was probably similar to our present alkanet. Hair dye was also known at that period.

The Romans, during their early history, showed very little interest in perfumes, and when King Antiochus and Asia were subdued, an edict was published in Rome (about 188 B.C.) forbidding anyone to sell exotics (unguents). It was only after their migrations into southern Italy, then occupied by the Greeks, that they acquired a more intimate knowledge of the æsthetic side of life. Nero became

[1] Probably Kostus.

Emperor of Rome in 54 A.D., and by this time both perfumes and cosmetics had assumed an important rôle at his court. He personally used cosmetics liberally, and his wife Poppæa made no secret of the artifices of the toilet. Amongst the many things they used were white lead and chalk to whiten the skin; Egyptian kohl for the eyelids and lashes; *fucus*, a sort of rouge, for the cheeks and lips; *psilotrum*, a kind of depilatory; barley flour and butter as a cure for pimples, and pumice-stone for whitening the teeth. The ultra-fashionable ladies of the Roman court devised a method for bleaching their hair by means of a sort of soap which came from Gaul. The centre of the perfume and unguent industry in Italy was situated at Capua.

According to Suetonius[1] at the funeral of Poppæa, Nero consumed more incense than Arabia could produce in ten years.[2] In his golden palace the dining-rooms were lined with movable ivory plates, concealing silver pipes, which sprayed on the guests a stream of highly odorous perfumes. It is, of course, well known that the Romans made considerable use of the bath and erected some of the finest bathing establishments, ruins of which can still be seen.

The Romans devised all sorts of beautiful containers for their perfumes and unguents, of which there were three principal kinds :—

1. Solid unguents, or *hedysmata.*
2. Liquid unguents, or *stymmata.*
3. Powder perfumes, or *diapasmata.*

The solid unguents were generally of one specific perfume, such as almond, rose, or quince. The liquid unguents were most frequently compounds containing flowers, spices, and gums, and followed very much on the lines quoted above from Theophrastus. The constituents were generally digested in one or other of the fixed oils, such as sesame, olive, or ben.[3] According to Pliny,[4]

[1] Book VI. [2] Pliny says one year, Book XII, Chap. 41.

[3] One of the earliest Roman nobles invented Frangipanni, and this is the only perfume which has withstood the test of time. A monograph on it appears in Volume I. [4] Book XIII, Chap. 2.

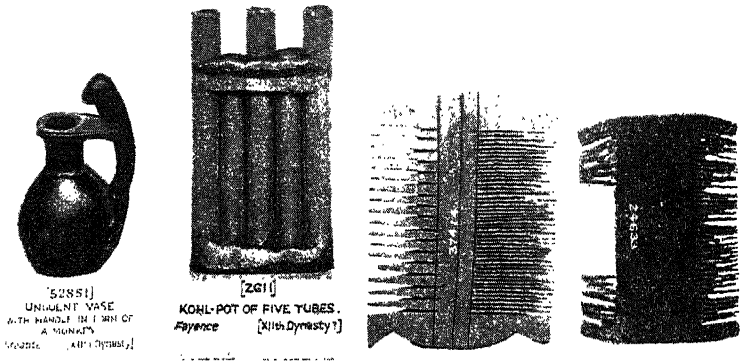

FIG. 6.—The Roman Combs are about 100 A.D.

FIG. 7.—Kohl Tubes in coloured glass. XVIIIth Dynasty, about 1450 B.C.

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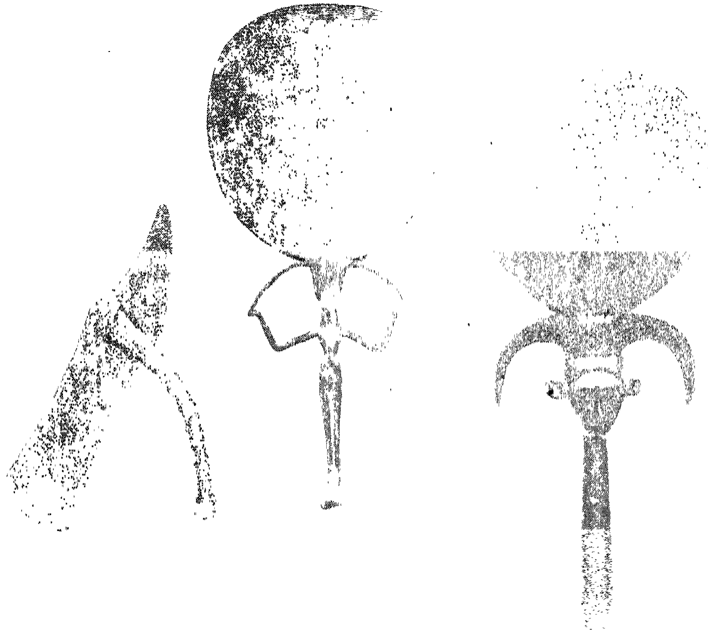

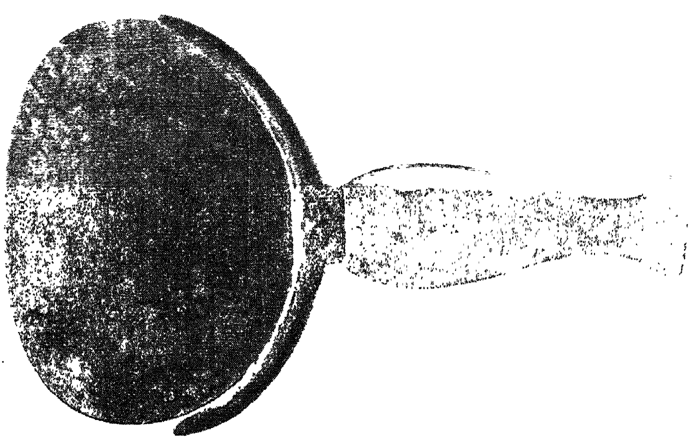

FIG. 8.—Above. Razor and Mirrors about 1400 B.C.

FIG. 9.—Below. Hawk Mirror, about 1000 B.C.

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resin and gum were added to fix the odour in solid perfumes; "indeed," he says, "it is apt to die away and disappear with the greatest rapidity if these substances are not employed." This writer also notes that unguents improved with age and for that reason were stowed away in lead containers. They were tested on the *back* of the hand and not on the palm, owing to the heat thereof having a bad effect on them.

In the centuries that followed the Arabs seem to have delved into the serious side of perfumery more than any other race. For instance, in the tenth century an Arabian doctor by the name of Avicenna made efforts to extract the perfume from flowers by distillation, which at that time was imperfectly understood. He was fortunate enough, however, to isolate from the rose some of its perfume in the form of oil or otto (attar) and to produce also supplies of Rose Water. Quite a trade in this latter article was developed in later years by the Arabs.

The Oriental women lead a somewhat secluded life, and one of their principal interests is in the enhancement of their personal beauty. As a toilet article of importance kohl probably stands pre-eminent. Of secondary importance is a complexion powder named *batikha* which is made from powdered marble, rice, borax, etc.

Concerning the history of perfumes and cosmetics in Britain there is no doubt but that, in a crude way, the early inhabitants of this country derived some pleasure from adorning their bodies with paints, etc. The Picts undoubtedly obtained their name from *picti*—painted, because of the elaborate designs they painted on their persons.

The importation of perfumes from the East dates from the time of the crusades, when the knights, returning from their conquest, brought with them many of the much-prized toilet articles used by the ladies of the harem. From this time until the reign of Queen Elizabeth perfumes and cosmetics became more and more popular; this vogue was not confined to our island but spread equally quickly throughout France and Italy. A peculiar habit, which has been attributed to Frangipanni, was the wearing of perfumed gloves—the trades of perfumer and glover having become one. About the same period the first alcoholic perfume appeared and is still known as Hungary Water.[1] The origin of this is attributed to Queen Elizabeth of Hungary who first prepared it in the year 1370. At the court of Queen Elizabeth of England both sexes made use of every kind of aromatic for perfuming the body and many new kinds of cosmetics for adorning the person. Powder and patches were all the rage and will always be associated with the reign of this extravagant Queen. The toilet preparations employed by the ladies of the court were kept in strongly perfumed boxes called *Sweet Coffers*. These were considered a necessary part of the furniture of their bedrooms. A recipe for making a beautiful complexion at this time was to first take a very hot bath to induce excessive perspiration, and this was followed by washing the face with plenty of wine to make it fair and ruddy. This latter treatment was even in those days fairly expensive, but Mary Queen of Scots is alleged to have even *bathed* in wine on which account she applied for an increased allowance! This luxurious habit was not uncommon with the elder ladies of the court, but the younger ones had apparently to be content with milk.

With the advent of the Commonwealth all these luxuries were discarded, but as soon as Charles II. was restored to the throne they became popular again. In later years the ladies of the court adopted a new practice by popularising powdered hair, but this soon fell into disuse. By the seventeenth century cosmetics were used to such an extent by nearly all classes that in 1770 an act was introduced into the English Parliament which was intended to afford some protection to those men who were beguiled into matrimony by the artificial adornments of the fair sex. This Act is as follows:—

"That all women, of whatever age, rank, profession, or degree, whether virgins, maids, or widows, that shall, from

[1] Consult the chapter on Toilet Waters for manufacturing details.

and after such Act, impose upon, seduce, and betray into matrimony, any of his Majesty's subjects, by the scents, paints, cosmetic washes, artificial teeth, false hair, Spanish wool,[1] iron stays, hoops, high-heeled shoes, bolstered hips, shall incur the penalty of the law in force against witchcraft and like misdemeanours and that the marriage, upon conviction, shall stand null and void."

Whether this Act has since been repealed is not known, but it is certainly quite evident that its appearance did not by any means abolish the use of cosmetics and perfumes.

The town of Grasse soon sprung into fame as the seat of the natural flower perfume industry, and by reason of its ideal situation has been able to maintain its premier position. Attempts have been made in other parts of the world to cultivate different flowers for the extraction of their perfume, but beyond the production of experimental quantities, there is, as yet, no serious competitor. In the course of time numerous fragrant oils have been distilled from plants in other parts of the world, and, together with the more recently introduced synthetics and natural isolates, constitute the very wide range of raw materials from which the perfumer blends the alluring odours so delightfully marketed in the many exquisitely designed containers and packages.

To-day the use of cosmetics is almost universal, owing no doubt to the greater artistry with which they are employed and also in no less degree to the greater skill and knowledge with which they are prepared. The use by the manufacturer of dangerous ingredients has been discontinued, and cosmetics can therefore be said to constitute a very valuable toilet asset.

To review[2] briefly their use :—

First—they are intended to cleanse.

Second—to allay skin troubles.

Third—to cover up imperfections ;

and Lastly—to beautify.

[1] Consult Carthamin in Volume I.

[2] This has previously appeared in an article by the author, "The Use of Cosmetics, Ancient and Modern," in the "Irish Chemist and Druggist" (1923), 231.

To take a simple example of each type will show they all have a legitimate use. Cold cream consists of a finely divided emulsion of fat or oil, which, when applied to the epidermis, removes all adherent dust and skin debris ; when it is subsequently rubbed off, the skin is left fresh and white—incidentally healthier for the application. It functions in another way also, for when applied after some kinds of soap, which contain free alkali, it neutralises any drying effect the soap may have had and keeps the skin in a supple condition. Other products having a similar action are creams containing fairly large proportions of lanolin. This fat is closely allied to the natural fat of the skin, so that it acts as a food to the skins of those persons who have a deficiency of natural fat. In such subjects, eczema is prone to develop—thus lanolin creams undoubtedly help to prevent skin troubles.

Then again, there are talcum powders, which are intended primarily to allay any irritation of the skin. This trouble becomes much more apparent in hot climates, where the consumption of this product is tremendous. In quite another direction there are mouth washes and dental creams. They contain such substances as thymol, which cleanse by reason of their action on the micro-organisms present at all times in the mouth.

It is in connection with the third and fourth uses, however, that the alleged harmfulness of cosmetics finds expression. The arguments generally advanced may be reduced to three—*first*, that by the excessive use of inferior face creams and powders the pores become enlarged and the skin flabby in consequence ; *second*, that undue friction is necessary in the use of rouge ; and *third*, that cosmetics contain ingredients which are injurious.

To take the last argument first : If these products consisted of such substances as white lead, mentioned earlier in this chapter, there would be some justification for the assertion, but they do not. Some so-called "skin-beautifiers" contain small quantities of corrosive sublimate which in itself is poisonous, but the minute quantities employed act rather as a skin antiseptic.

Concerning the second: Ladies who want to use rouge will use it, no matter what advice may be given to the contrary. It has a tendency to block the pores, and will do no harm if removed within a few hours. Lipsticks as now made have their melting-point such that they soften immediately on application to the lips—hence the amount of friction is so small that it can be disregarded. At one time it was customary for ladies to rely on complexion pills for the "bloom of youth," but to-day they find it much more satisfactory to spend their money on external applications which do give the desired result, rather than on internal remedies from which results are frequently problematical.

Perhaps it is in connection with the first argument that most misconception exists. Face creams and, in particular, vanishing creams, are much used as a basis for face powder. They give to the skin a matt appearance and so cover slight imperfections. It is just possible that some of them are of such a consistency that they do block the pores temporarily, but the best are so compounded that they act as cleansers as well as powder creams. The film covering is so thin that it cannot possibly do harm, but on the contrary acts as a protecting agent against the sun. When face powder is lightly dusted on, the evaporation surface is increased, and a consequent cooling during the evaporation of perspiration is experienced.

Like all other things, the use of cosmetics carried to excess might be harmful, but the fact must not be denied that those who take the trouble to enhance their personal attractiveness are a much greater asset to this world than those who are slovenly and neglect their bodies.

Face massage is much appreciated by those who desire to retain a clean, supple, and unwrinkled complexion, but modern surgical science has evolved a treatment known as *Face Lifting*, by which wrinkles can be removed or filled up with plastic paraffin base, the shape of the nose improved, and defects to the chin and ears eliminated. The operation is performed with local anæsthetics under highly antiseptic conditions and without danger.[1] This method of rejuvenescence does not, however, pretend to dispense with the use of cosmetics, since plastic surgery only improves contour. A lady of 50 years can lose by this means 20 years of her apparent age, but even so she will use cosmetics to enhance her tightened skin and to give her complexion just that éclat which is demanded by the clothes she wears and the society she cultivates.

[1] In view of the number of quacks who practise, it is best to entrust one's face to the hands only of the qualified surgeon specialist.

CHAPTER II.

THE PRODUCTION OF NATURAL PERFUMES.

1. The perfume in the plant.
2. Agricultural research.
3. Times of new crops of the more important oils, flowers, etc.
4. The separation of odoriferous materials from the plant by means of
   (*a*) Distillation.
   (*b*) Expression.
   (*c*) Extraction by enfleurage, maceration, and volatile solvents
5. Statistics.

THE PERFUME IN THE PLANT.

NATURAL perfumes, one of the most marvellous phenomena of plant metabolism, probably reach their highest degree of excellence in the fragrance exhaled by fresh flowers. This fragrance is due to the minute traces of essential oil which exist in the petals, sometimes in the free state, as in rose and lavender, and occasionally in the form of a glucoside which, under favourable conditions, is decomposed in the presence of an enzyme or ferment, as in jasmin and tuberose. The existence of a volatile oil, however, is by no means confined to the inflorescence, but frequently occurs in other parts of the vegetable organism.

For example, it is found in the

Flowers of, cassie, carnation, clove, hyacinth, heliotrope, mimosa, jasmin, jonquille, orange blossom, rose, reseda, violet, and ylang-ylang.

Flowers and Leaves of, lavender, rosemary, peppermint, and violet.

Leaves and Stems of, geranium, patchouli, petitgrain, verbena, and cinnamon.

Barks of, canella, cinnamon, and cassia.

Woods of, cedar, linaloe, and santal.
Roots of, angelica, sassafras, vetivert.
Rhizomes of, ginger, orris, and calamus.
Fruits of, bergamot, lemon, lime, and orange.
Seeds of, bitter almonds, anise (both kinds), fennel, and nutmeg.
Gums or *Oleo-resinous exudations* from, labdanum, myrrh, olibanum, Peru balsam, storax, and tolu.

Then again, different varieties of plants produce aromatic bodies of slightly dissimilar odour, as is shown by the numerous roses, such as the red rose, the white rose, and the Maréchal Niel, while yet again, the *same* plant, grown under different conditions and in different soil, will often yield an essential oil of entirely different bouquet, as is demonstrated by the lavender of Mitcham and of France or by the geranium of Vallauris and of Bourbon.

All these remarkable variations present a problem which has for many years been studied by numerous distinguished scientists, among whom may be mentioned Mer, Mesnard, Maquenne, Tschirch, Dr. Eugene Charabot,[1] and his co-workers, Messrs. Gatin,[2] Hébert, and Laloue.

The theories advanced by some of these earlier workers concerning the formation of the essential oil in the plant is worthy of note.

Mer (1887) thought starches and cellulose were the starting-point in resin formation, preceded by that of essential oils.

Tschirch (1906), one of the greatest authorities on resins, agreed that the formation of the oil preceded that of the resins in the cell, but that they were produced from materials accumulated in the membrane of the cells bordering on the secreting canal.

Mesnard at an earlier date (1894), however, was of the opinion that essential oils were degradation products of chlorophyll. In the flower they are localised in the cells

[1] Charabot, "Les principes odorants des Végétaux" (1912).
[2] Charabot and Gatin, "Le parfum chez la plante" (1908).

of the internal surface of the epidermis where by photosynthesis the chlorophyll is converted into essential oils, etc.

Maquenne more recently thought perseite and other polyhydric alcohols containing more than six-OH groups were the starting-point in the formation of aromatic terpenes.

All these workers considered the essential oils to be excretory products formed during the metabolism of substances which functioned in the life of the plant. They considered, further, that their property of odour had a distinct relationship to the functions of insects and of animals, but very little to that of life in the vegetable kingdom.

Charabot and Laloue, in the course of experiments conducted over a number of years, were able to show that in many cases the essential oil did in fact originate in the chloroplast, and resulted from the assimilative work of the chlorophyll.

Concerning the formation of individual constituents of essential oils the following are the generally accepted views :—

Alcohols formed first in the chloroplast.

Esters, by the action of acids on the alcohols in the chloroplast.

Hydrocarbons, by dehydration of alcohols in the chloroplast.

Terpene alcohols, by isomerisation.

Acids, from the decomposition of proteins or from the oxidation of carbohydrates.

Aldehydes, from the rapid oxidation of alcohols principally in the inflorescence. Action hastened during fecundation and growth of fruit.

Ketones, probably in the same way as the aldehydes.

Phenols, either from the splitting up of proteins or of aromatic acids.

The problem of the evolution of these odoriferous constituents of the vegetable kingdom embraces the following points :—

(*a*) The formation and circulation of the odoriferous constituents.

(*b*) Their evolution and the mechanism of that evolution.

(*c*) The creation of the perfumes themselves.

(*d*) Their physiological influence on the plant.

In an important communication to the Académie d'Agriculture de France,[1] Dr. Charabot elaborates these points most clearly by considering the perfume first in the case of the whole plant and then in the case of the flower only.

He says : "When the plant is examined the odoriferous materials only appear in the young organs and continue to form and accumulate with decreasing activity until blossom time ; by diffusion they go from the leaf to the stalk and thence to the flower.

"During the process of fecundation a certain quantity of essential oil is consumed by the inflorescence, and as a practical consequence the gathering of perfume-producing plants should be made just before fertilisation is accomplished. Once this process is complete the fragrant principles redescend into the stem and diffuse into the other organs, that migration being stimulated by the drying of the inflorescences, which increases the osmotic pressure and partially precipitates the less soluble products.

"In considering the flower only, it is known that certain varieties (after collection) produce fragrant bodies when placed in such a condition that their vital functions may still be exercised, while in other cases the flower contains all its odoriferous principles in the free state, and it is impossible for it to produce new fragrant materials, even though it be still living."

The conclusions arrived at by Dr. Charabot after a study of the evolution of odoriferous compounds and of their mechanism are as follows : "The esters, so frequently found in essential oils, are formed in a particularly active manner in the green part of the plant, by the action of acids on the alcohols. This phenomenon, characteristic of the chlorophyll region, is influenced by an agent, probably a

[1] "La Parfumerie Moderne" (1921), 76.

diastase of reversible action, which functions as a dehydrating body. The influences capable of modifying the plant in order to adapt it to an intense chlorophyllic action at the same time aid the formation of esters, this being favourable to the mechanical elimination of water.

"Thus, the functions of chlorophyll tend to acquire a new significance; not only do they assure the fixation of carbonic acid gas by the vegetable tissues, not only do they, in assisting transpiration, effect the circulation of the liquids which bring and distribute the materials necessary to the mineral nutrition of the plant, but they also, during the assimilation of carbon, actively assist condensation, enabling the transformation of a simple chemical body into one of those innumerable complex substances, the study of which has puzzled the shrewdest chemist.

"When the alcohol is in the proper state to easily lose the elements of water, it gives birth to the esters and the corresponding hydrocarbon at the same time, or briefly put, the first transformation takes place in the chlorophyll region by way of dehydration.

"On the appearance of the flowers (those organs in which the fixation of oxygen by the tissues is particularly intense) it is possible that the alcohols and their esters are converted into other oxygenated products, the aldehydes or ketones, with at the same time the liberation of the energy necessary for fecundation.

"A large number of odoriferous materials, varying greatly in their functions and their chemical structure, may be produced by the splitting up of glucosides. When the generality of such a mechanism is admitted, it is easy to give an explanation of the observed facts relating to the formation of odoriferous materials and to their sudden appearance in this or that part of the vegetable organism. If the glucoside, which is formed in the green part of the plant, immediately encounters a medium whose conditions are favourable to its decomposition, the essential oil appears there at once and begins to circulate, to perform evolutions, and to play its part. In other cases, the glucoside will only meet the ferment capable of splitting it up in the flower. Only after having circulated in the plant and reached the flower, being modified more or less the whole way, will the glucoside be able to liberate the constituents of the essential oil. The flower only will then be odoriferous. The formation, in certain flowers, of new quantities of essential oil in proportion to the quantity of essence removed is explained by the phenomenon of chemical equilibrium, resulting from the reversible reaction :

Glucoside-water $\rightleftarrows$ glucose-essential oil.

"The production of essence ceases when the state of equilibrium is attained. But, when the odoriferous material is removed in proportion to its formation, the reaction of division can go on until the whole of the glucoside is decomposed. From these conclusions it will be easy to understand their application in the extraction of flower perfumes, especially by enfleurage."

With regard to the physiological influence of aromatic materials, it was assumed formerly that they were of little use in the vegetable organism. It has been noticed by Dr. Charabot and his co-workers, that, on the contrary, they can be employed by the plant, especially when the latter is sheltered from the light and does not assimilate the carbonic acid gas of the air with the same power. They participate in a normal manner in the work of fecundation and of the formation of the seeds, during which time they are partially consumed. Other hypotheses put forward to account for the part played by the essential oils in the life of the plant are as follows :—

Ciamician and Ravenna think they may act as hormones, and thus act as excitants in the fecundation of the flower.

Pokorny considers them to be waste products because they are generally toxic both for lower organisms and for higher plants. Tschirch thinks they are waste products from which the resins are formed and are therefore incapable of circulation again in the plant.

Frisch takes the view that odour is more effective than colour for attracting pollen-laden insects, but that the essential oil has other functions is not disputed.

The suggestion that the volatile oil may be a protecting agent against plant parasites will not hold water because unfortunately odoriferous species are just as much subject to invasion as non-odorous plants.

Before leaving the subject of plant metabolism let us take a concrete example of the marvellous changes which occur in the composition of an essential oil—namely, that which is produced by the orange plant. If an essential oil is distilled from the inflorescences when they are in full flower and before fecundation has taken place, the product will have a comparatively high content of esters and other oxygenated bodies and be relatively low in terpenes.

If the orange flowers are fertilised and the fruit allowed to develop slightly, an essential oil is obtained on distillation that contains much less oxygenated constituents and a larger proportion of terpenes than the oil distilled from the fresh flowers.

Again, supposing the fruit is allowed to become fully grown and the essential oil expressed from the mature peel, it will be found that the oxygenated constituents have decreased to an almost negligible percentage and their place has been taken by terpenes.

AGRICULTURAL RESEARCH.

The production of perfumery raw materials is an important French industry, and a few years ago received some attention from the French Government. A department of the Ministry of Commerce and Industry, under the Presidency of Professor Emile Perrot, deals exclusively with the plants, etc., grown for the Perfumery and Drug trades. The former section is under the supervision of Dr. R. Cerighelli, who in 1925 hoped to establish at Grasse an institution fully equipped with research laboratories and experimental gardens, where all problems intimately connected with the French perfumery industry could be studied. These hopes did not materialise, so in the latter part of 1927 important interests in the Grasse district established an agricultural experimental station having similar objects. This is called "Association de Jardin d'Essai des Plantes à Parfums l'Arrondissement de Grasse" and is controlled by the leading Grasse houses.

The main objects of research will be to help cultivators of plants in a practical way whereby they may preserve and improve their output in quality as well as quantity, and select as well as stabilise the best varieties of plants to grow. This point is of great industrial interest because at present flowers and plants are sold to the works for extraction upon a weight basis and not upon the yield of essence. Obviously therefore the growers' aim is at present to obtain a big yield of plants which may often be at the expense of the Absolute Flower Oil. Other points which are sure to receive the attention of the association are : drainage, irrigation, rotation of crops, fertilisers, and parasites.

TIMES OF NEW CROPS.

January.—Bois de rose, clove, linaloe, bergamot, lemon.

February.—Cassie, mimosa, bergamot, lemon.

March.—Violet, citronella, clove, Bourbon geranium.

April.—Jonquil, narcissus, hyacinth.

May.—Rose, orange blossom, rosemary, Bourbon vetivert, Algerian geranium, linaloe, thyme.

June.—Rose, carnation, petitgrain, cassie, bois de rose, vetivert, Bourbon geranium.

July.—Jasmin, French lavender, Algerian geranium, lime, rose, rosemary, thyme.

August.—Jasmin, tuberose, lavender (English and French), caraway, lemon-grass, English peppermint, Florentine orris.

September.—Aniseed, jasmin, tuberose, Ceylon citronella, English lavender, palmarosa, English and American peppermint, spearmint, French geranium.

October.—Jasmin, tuberose, caraway, spike lavender, Sicilian orange, palmarosa, French geranium, Florentine orris.

November.—Cassie, Bourbon geranium, lemon, lime, American peppermint and spearmint, santal (Mysore auctions).

December.—Cassie, bergamot, lemon, lemon-grass, palmarosa.

THE SEPARATION OF NATURAL ODORIFEROUS MATERIALS.

Production.—The manufacturing processes employed may be conveniently classified as follows :—

1. *Distillation* (geranium, lavender, neroli, rose, etc.).
2. *Expression* (citrus oils).
3. *Extraction* by means of (*a*) enfleurage, (*b*) maceration, (*c*) volatile solvents.

Distillation.—This process in a crude form dates back to the times of the ancients,[1] when fire was regarded as a supernatural element. Among the earliest types of apparatus were the *Cucurbita*, the *Alembic*, and the *Berchile*, from which has gradually been evolved the distilling apparatus of modern times. The process of evolution was slow up to the middle of the last century, but was hastened in later years, largely on account of the remarkable advances made in the perfume industry. During this period the improvement in the construction of steam and vacuum stills has not only increased and cheapened the yield of oil, but has also materially enhanced the purity of the product. It does not, of course, follow that the employment of modern apparatus is universal, for even to-day, in more or less remote parts of the world, comparatively crude open fire stills are used, and their careless manipulation is frequently responsible for the oils of indifferent quality occasionally met with in commerce.

Volatile oils, as a general rule, are highly odorous, mobile

[1] Possibly as far back as 7000 B.C. "Report" of Schimmel & Co. (1926), 172.

liquids, and may be obtained from the plant by steam distillation without undergoing decomposition. They usually contain numerous individual bodies, differing in chemical constitution, and to one or more of these the characteristic odour of the oil is due. In many cases, these particular constituents have been definitely established, as, for example, the odour of almond oil is attributed principally to *benzaldehyde*, of bergamot oil to *linalyl acetate*, and of clove oil to *eugenol*. In several cases, however, where the oil is of more complex composition, the characteristic odour is believed to be due to the perfect blending of a number of the aromatic constituents. This is well illustrated in the case of otto of roses, where the esters of the alcohols *geraniol* and *citronellol*, together with the *higher aliphatic aldehydes*, although present in very small quantities, undoubtedly play an important part in the determination of the distinctive rose odour.

Different distillation processes are employed for separating the essence from the plant, and the choice of method depends upon the nature of the product and the yield that can be obtained. Several factors contribute towards the amount of essential oil that can be "won" from the plant, and not least of these is the attention paid to its cultivation. In many cases, of course, the plant grows wild, and no effort has been made to study the particular kind of manure that could be used to materially increase the yield of oil. In a few instances, however, the importance of this part of the "process" has been realised, and in the case of lavender proved by the experiments of Professor Zaccharewitz, of Avignon, who found that the yield of oil could be more than doubled by the use of an artificial manure consisting of sodium nitrate 1, potassium chloride 1, calcium superphosphate 3. Another important factor is the preparation of the plant for the still, and upon this will depend not only the yield of oil but also the rapidity with which the process may be completed. The state of the raw material must be such that the steam or water can completely permeate the mass and carry over with it into the condenser every particle

[*A. Chiris.*

FIG. 10.—Distillation by Fire in the Mountains.

[*To face page* 30.

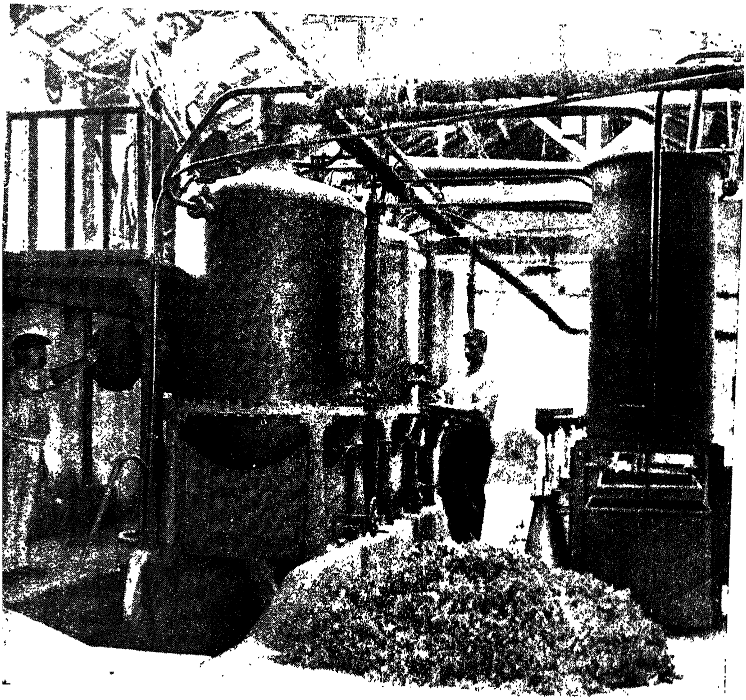


FIG. 11.—Distillation Plant. [Pilar Frères.

[To face page 31.

of essential oil present. In many cases, such as flowers, leaves, and grasses, the raw material requires no special treatment, but sometimes the complete extraction of the volatile oil would be impossible without its previous preparation. In the case of hard, woody bodies, shaving or grinding may be necessary, in the case of some fresh roots or whole herbs they may be dried and then cut, while yet again in the case of seeds, fruits, and barks, crushing or disintegration may prove sufficient. In a few instances, notably berries, these preliminary preparations may be unnecessary because the epidermis is broken by internal pressure, induced by the high temperature of the steam. Raw materials are seldom placed in the still in a *fine* powder since they are apt to form an impenetrable mass when the steam is turned on. In consequence this escapes either round the sides or through cracks, and the major portion of the charge remains untreated.

In some parts it is the common practice to dry the raw material before distilling, but this may be due to the distance of the place of collection from the apparatus or to the congestion of the stills at the time ; in the case of orris the drying of the roots is necessary for the development of their odour.

The processes of distillation may be divided broadly under the two following heads :—

1. By boiling with water.
2. By means of steam (" dry or live ").

The first method is the oldest and the easiest. It is still applied by the peasant who grows his own plants and is too far from the factory to convey them there. With careful application good results are obtained, but if a part of the raw material should not be covered with water and come in contact with the hot sides of the apparatus, destructive distillation takes place with the production of obnoxious bodies and a consequent impairment of the odour of the final product.

This last danger is overcome by the application of the second method, when the steam is produced in a boiler or other vessel away from the still. In this case the apparatus is fitted with a steam jacket, or a steam coil (for "dry steam" distillation), and also with a "live steam" inlet (see Fig. 12). Either system may then be used, and if necessary may be conducted under reduced pressure (*in vacuo*). The methods adopted for supporting the raw materials inside the still

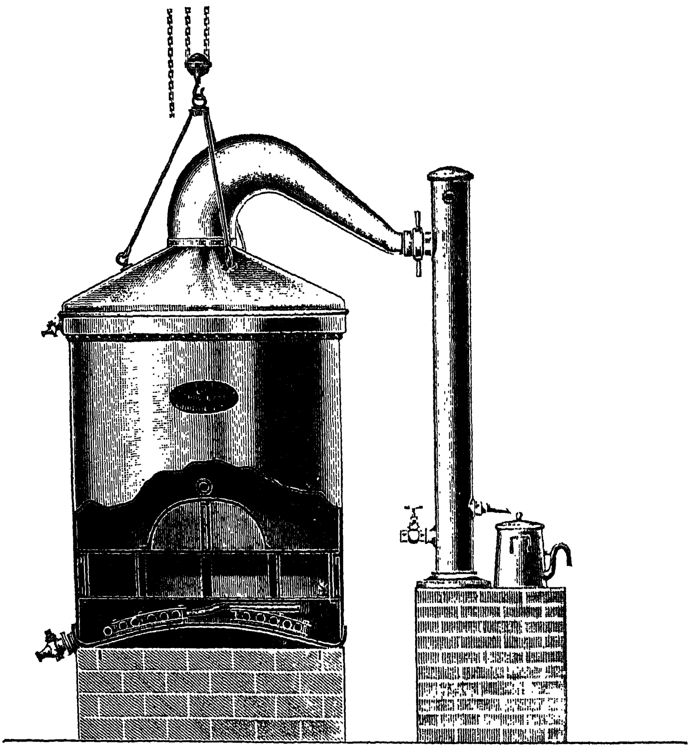


FIG. 12.—Type of apparatus used for the distillation of plants such as Peppermint and Lavender. It has a capacity of 1200 gallons and will take a charge of one ton. The exhausted herb is discharged by lifting the false bottom.

vary—in many cases a perforated sheet of metal or false bottom is used (see Fig. 12), while in others a basket of the same diameter as the still and fitting closely to its sides is suspended from the top and is easily removed.

The rate of distillation of the essential oil depends mainly on the condition of the raw material and the rate at which the volatile oil is liberated from it. This is influenced to some extent by its vapour pressure and the molecular weight of its constituents.

Condensation is effected by means of water-cooled coils

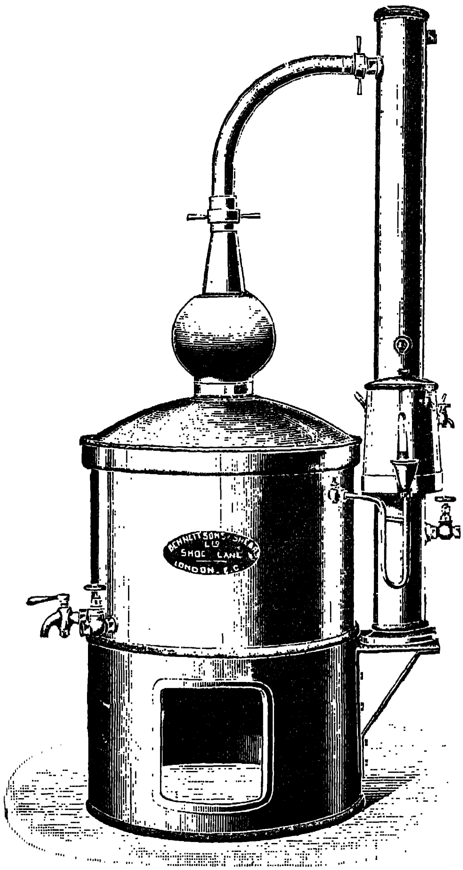


FIG. 13.—Still used for the Extraction of Essential Oils. It is fitted with a separator and connection for returning the aqueous distillate to the still.

or vertical tubes, the latter being very efficient and rapid for many products. If they are too fast, however, air cooling is resorted to as in the case of orris oil. To save the space and the cost of the enormous length of tube necessary for air cooling, worms can be inserted in warm water kept at any specific temperature by means of a thermostat and condensation efficiently effected.

Many ingenious forms of receivers are in use whereby the oil flows from one exit and the condensed water runs back into the still automatically (see Fig. 13). Florentine flasks are also used, both singly and in cascade. In the case of crude oils rectification is effected by redistillation with steam.

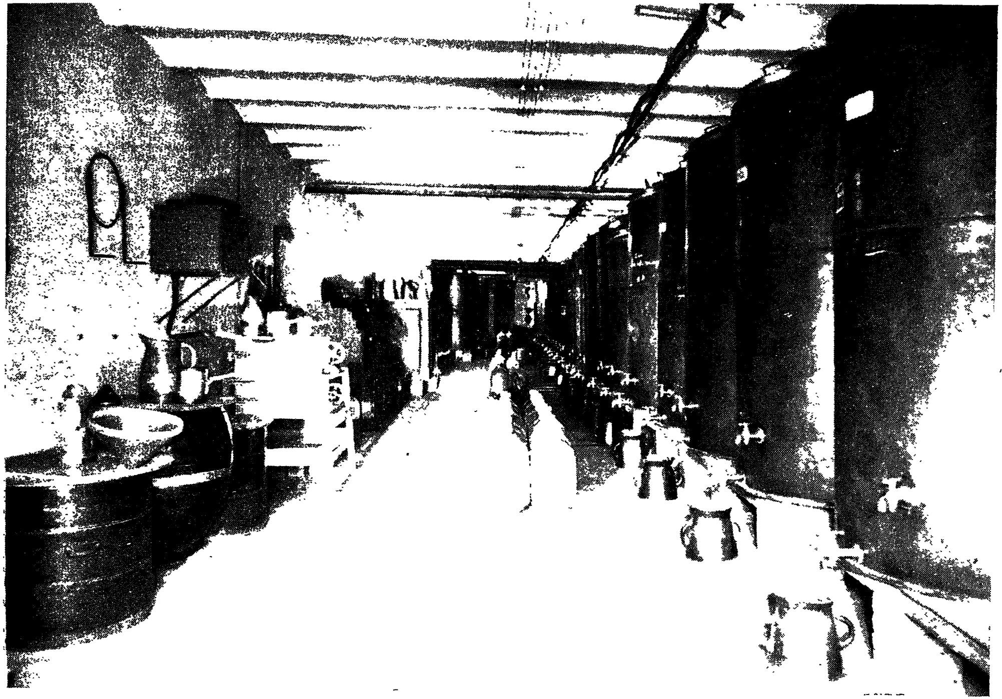
In a number of instances, notably in those of orange flower and rose, the oil, or some of its constituents are slightly soluble in the aqueous distillate, and even by subjecting the fragrant water to cohobation the complete separation of the volatile oil is difficult and frequently impossible. Such waters are stored as shown in Fig. 14, and enter commerce as Aqua—Trip.

In some works these waters are specially prepared and are then known as "weight-for-weight" products. For example, 100 lb. of roses and a sufficient quantity of water are distilled until the yield is 100 lb. of fragrant rose-water. Sometimes the distillate is separated into two or even three fractions; the first 50 lb. constituting the *quadruple superior*, and the remainder the *triple superior.*

A patent has been taken out by the directors of Messrs. Roure-Bertrand Fils for the separation of oil dissolved or suspended in distillation waters. This is conducted from the separators to a tower filled with coke, through which steam is blown. The steam carries away the oil and transports it to the condenser and the separator.

Expression.—There are three main processes for the separation of so-called *Citrus* oils from the peel of the lemon, orange, bergamot, and lime. They may be described as—

(*a*) Sponge process.
(*b*) Ecuelle method.
(*c*) Machine process.



[*Roure-Bertrand Fils.*

FIG. 14.—Storage of Floral Waters.

[*To face page* 34.

The first is applied to lemon and orange oils; the second was at one time employed for lemon oil but is now little used; the third on a large scale is applied mainly for the production of bergamot oil, but, as described below, machines have been devised to deal efficiently with lemon oil also. A small quantity of oil of limes is prepared by the sponge process, but as is well known the major portion of the oil of commerce is obtained as a by-product of distillation in the West Indies.

The Sponge Process.—The oil cells of the rind of any of the above fruits are easily broken, as can be shown by turning a piece of lemon peel backwards. This process on a large scale, therefore, does not offer any serious difficulty, nor does it require very heavy pressure for the extraction of the oil. It may be divided into three stages: (1) the preliminary preparation of the peel; (2) the expression of the oil; (3) the clarification of the oil. According to the manner in which the preliminary operation is carried out, so is the process named. When the fruit is cut across the shorter axis and the pulp removed by a spoon, it is known as the *Scorzetta*, and the sponges used are cup-shaped. When the rind is cut off in three strips and the pulp remains intact, it is known as the *Spugna*, and the sponges are flat or nearly so. This stage of the process is comparatively light work and is done by women. Before expression, the peel is either moistened with or steeped in water, which is supposed to facilitate the removal of the oil by making the cells more turgid. The drained peel is pressed by men who sit on low forms and allow the oil to collect in a shallow earthenware bowl in front of them, the sponges used for the purpose resting on sticks attached to the edges of the receiver. The oils from the different jars are mixed and allowed to stand until any juice has separated at the bottom. It is afterwards filtered and stored in coppers. Any residues that may contain oil are diluted with water and the oil recovered by distillation. Such products are always of poor quality and are therefore mixed with better oils. The hemispherical rinds from the *Scorzetta* process are pickled with salt and exported as *Salato*. The juice from the pulp is used in the production of *Citrates*.

The Ecuelle Method is practised more in the north of Italy, and consists of rolling the fruits about in hollow vessels, the walls of which are covered with spikes. The oil cells are punctured, and the liquid flows to the bottom, being collected in a receptacle situated in the handle of the vessel. The product is then clarified as described above.

Machine Processes have been applied in the manufacture of lemon and bergamot oils during recent years. One for the production of lemon oil consists of a mechanical adaptation of the sponge process, when the pressure is applied with a lever. Another hand machine consists of two channels between which the fruit is rolled ; the skin is lacerated by means of spikes, and the mixture of oil and juice is collected and subsequently separated and clarified as above described. A complete account of this is given by P. Mirgodin, in "La Parfumerie Moderne" (1921), 257. Still another machine of similar type, mechanically driven and dealing with graded lemons, is described in the "P. and E.O.R.," special issue (1922), 208. Another machine has recently been described by Ajou.[1] The fruits are freed from pulp and then the rind is placed between two rotative wire sieve-like plates. The oil is thus pressed out and collected. Imperfectly pressed peel is treated with sponges. The most modern and efficient process, however, is that devised by Mr. Alex. H. Bennett of Messina, in which centrifugal separators are employed. The following abstract of this process is reproduced by kind permission of the editor of the "P. and E.O.R.," and is best understood by a reference to the diagram which appeared in the special issue (1922) of that valuable paper : "The whole fruit, without any previous preparation other than washing, is crushed in a mill between two pairs of rollers

[1] "Revist Ital. delle Ess. e. prof.," 5 (1923), 110.

placed vertically, one below the other. In this process the essence-bearing cells of the peel are all broken and the essence thus liberated mingles with the juice simultaneously squeezed out from the pulp. The rollers are surrounded by a watertight casing, and the hopper of the mill is covered by a close-fitting, dome-shaped lid, the fruit being admitted by a shoot at one side, while from the middle of the cover a fine spray of water is directed downwards on to the first pair of rollers, and assists in washing the mixed juice and essence away from the residues. The mass is discharged from the lower part of the mill on to a wide, wooden grating, which retains the crushed fruit and allows the liquid, carrying in suspension a considerable amount of solid particles, to pass freely through it. On this grating the pulpy mass is allowed to drain for some time, and is then transferred to presses of the form usually employed in citrate works, where the remaining juice is squeezed out. The liquid passing through the grating runs down the sloping bottom of the tank and through a tube to the drainers, made of sheet aluminium pierced with tiny holes. In these strainers collect the pips and the coarser particles of skin or pulp that may be carried down by the liquid, which thus, partially clarified, passes into a tank from which it is led by a tube to the centrifugal machines. These are of the milk separator type, somewhat modified internally to permit of the easy passage of suspended solid particles to the wall of the drum, and to allow space for the accumulation there. The rate at which the liquid enters the drum is controlled by a stopcock in the tube, and when this is properly regulated, clear essence is continuously discharged from the upper or cream cock of the centrifuge and collected in a suitable vessel, while juice freed from essence and containing but little matter in suspension is delivered from the lower cock and led by a pipe to an underground reservoir, whence it is pumped to the citrate-making plant as required. The centrifuges are employed in pairs, as after a certain period (one or two hours, depending on the state of the juice) the drum becomes overcharged with the deposit of finely divided solid matter, and must be dismounted and washed, the work being continued in the meanwhile by the other machine."

According to Smiths, Jacob & Co.[1] this process has not stood the test of time and is very little used nowadays.

The machine process for the production of bergamot oil dates from the beginning of the eighteenth century. The somewhat crude apparatus was invented by Mr. Auteri of Reggio, and consists of two circular-shaped discs, the lower one stationary and the upper one operated by geared wheels (either hand or power driven to-day). The discs are covered with either small knives or sharp points and the lower one is perforated to allow the oil to escape. The upper one is raised to insert the fruits and then lowered, the pressure being controlled by a lever. As the upper disc revolves the oil cells in the rind are lacerated and a bell rings to indicate when each batch is completely expressed. The oil escapes through the lower disc and is collected, being subsequently clarified and filtered. The fruits are afterwards cut up and the juice expressed for the production of citrates. (A most complete and up-to-date account of the Italian essence industry is contained in the "P. and E.O.R.," above referred to, together with much useful analytical data, etc.)

Extraction.—Reference has already been made to the separation of volatile oils from plants (*and their flowers*) by means of distillation, and in several instances this process yields oils of exceptional purity and of very fine aroma. In a large number of cases, however, the application of this method does not produce products which are entirely satisfactory on account of the fact that many unstable aromatic substances are damaged or completely destroyed by the high temperature of steam, while in other cases the *quantity* of essential oil that could be obtained would be negligible. In view of these facts, other methods are used for the separation of the fragrant bodies from the flowers,

[1] Schimmel's "Report" (1926), 52.

and they are known as **extractions by means of solvents.** The materials used for this purpose are broadly classified as **volatile** and **non-volatile,** while the latter are again subdivided according to the conditions of *temperature* appertaining during the process. These distinctions are clearly indicated as follows :—

1. Extraction by means of non-volatile or fixed solvents such as animal fats or vegetable oils.

(*a*) At normal temperatures—**Enfleurage.**
(*b*) With the application of heat—**Maceration.**

2. Extraction with **Volatile Solvents** such as petroleum ether, etc.

The choice of process depends upon several factors, the more important being :—

(*a*) That certain varieties of flowers produce fragrant materials when placed in such a condition that their vital functions may still be exercised.

(*b*) That other varieties of flowers contain all their odoriferous principles in the free state, and are unable to produce *new* fragrant materials, even if still living.

Among the former class may be included jasmin and tuberose, while typical examples of the latter are rose and orange flower. The process which is best applied to the extraction of the odoriferous bodies from any particular flower has been determined by many years of experience in the south of France.

Enfleurage is applied principally to jasmin and tuberose and sometimes to orange blossom, jonquille, muguet, etc.,

Maceration gives better results with cassie, rose, orange blossom, violet, etc.

Volatile Solvents are used for extracting reseda, rose, jasmin, jonquille, tuberose, violets, cassie, orange flowers, carnations, mimosa, heliotrope, oakmoss, stock, etc.

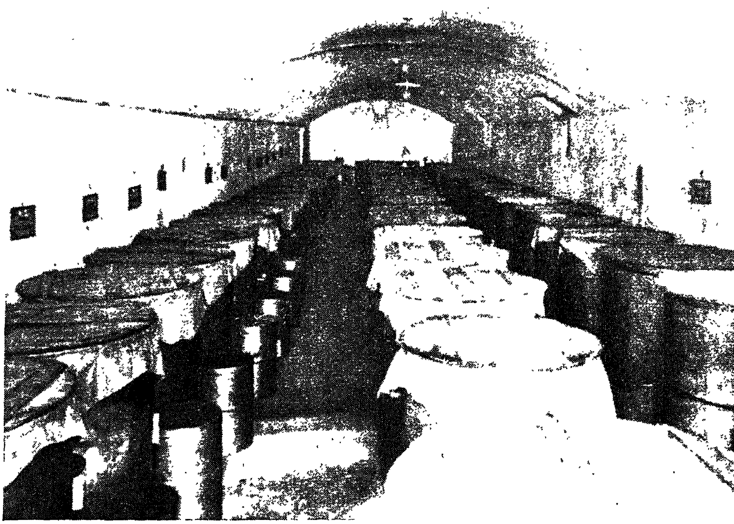
It will be noticed that certain flowers, such as rose and violet, may be extracted either by maceration or by volatile solvents, and a good product can be obtained by either process. On the other hand, certain flowers, notably jasmin, may be extracted by enfleurage or volatile solvents, but the product obtained by the former method is superior in odour rather than in yield. Niviere[1] gives the following explanation of these differences :—

"It is quite certain that the jasmin flower contains one or more glucosides. I had the opportunity of making a great number of experiments on the preliminary hydrolysis, and I always obtained a yield in essence greater than that obtained by a direct extraction without hydrolysis. However, if I compare the yields in essence by extraction with those by enfleurage, I notice that the differences are not very great, if only the extraction of *pure* essence is considered. During ordinary manufacture, 1000 kilos of jasmin flowers produce by enfleurage 5 to 6 kilos of pure concrete ; extraction by means of petroleum ether only gives 1·300 to 1·400 kilos of absolute essence ; the net yield accordingly seems to be 4 to 5 times greater by the enfleurage process. But it must not be forgotten that by this last method glycerides, rich in olein, are dissolved by the alcohol during extraction of the enfleurage pomade, and that in reality the jasmin concrete, from pomade, only contains 25 to 28 per cent of essence, the remainder consisting of fatty materials. What remains certain is that the two essences are different both in odour and in chemical composition, as demonstrated by Hesse. In the enfleurage product, the presence of indol is very noticeable, and is probably due to the splitting up of a glucoside under the influence of an enzyme. The fact of the vitality of the flower only intervenes in the direction of hydrolysis ; the flower no longer produces essence, but splits up by hydrolysis the odourless or insoluble materials before they are absorbed by the fats. The fats dissolve the essence by contact. The industrial practice shows that the flowers must be in contact with the grease. All experiments to save labour, based on the non-contact of the flowers with the fat, in order to obtain a quicker 'defleurage,' have

[1] "La Parfumerie Moderne" (1921), 225.

[*Lautier Fils.*

FIG. 15.—Enfleurage—placing the Blossoms on the Chassis.



[*Roure-Bertrand Fils.*

FIG. 16.—Storage of Pomades.

[*To face page* 40.

failed. Concerning the use of these two essences in perfumery, it may be asserted that the enfleurage product is more tenacious than the absolute one. That peculiarity arises from the glycerides of the fatty acids, which act as fixatives, and furnish also their sweet odour of fat. The objections to the use of concretes is that they produce extracts which become rancid after some months, especially if the containers have been exposed to strong light." This would appear to indicate that, if jasmin flowers were submitted to a preliminary hydrolysis by acid or enzyme, *before extraction with volatile solvents*, the yield of oil would be increased.

Enfleurage is the oldest perfumery process employed in the south of France. At one time it was used for extracting all blossoms, but modern methods have shown that better results can be obtained more economically with almost all flowers. The only important exceptions are jasmin and tuberose, and to these enfleurage possesses certain advantages dependent upon the fact that even after removal of the flowers from the stem, and while they are still in contact with the fat, the splitting up of glucosides continues with the production of essential oil which is absorbed and retained by the thin coating of grease. This fat yields the so-called "**pomades** for **washings**." The enfleurage process necessitates the use of "*chassis*," which are wooden frames, each supporting a glass plate. The cold or slightly warmed grease is uniformly distributed by means of brushes in a thin layer on both surfaces of the glass plate, a margin being left near the edges. The petals are then spread lightly on the fat as shown in Fig. 15, the absorption surface being increased by grooves made with a wooden spatula. Several chassis, thus prepared, are placed in tiers, as illustrated, so that the petals are enclosed between two layers of grease, both the upper and lower absorbing the perfume as it is given off. Fresh flowers replace the exhausted ones, daily in the case of jasmin, and every two or three days in the case of tuberose. The chassis are turned over for each alternate application so that an even distribution of perfume results. The renewal of the flowers continues until the fat is fully charged, the resulting product, after removal, constituting the **Pomade.** This is stored as shown in Fig. 16.

The fats most commonly used are lard or beef suet, or a mixture of the two in the proportion of two of the former to one of the latter. They are specially purified and washed with alum solution, afterwards being preserved by digestion with benzoin or tolu (sometimes with the addition of orange blossoms).

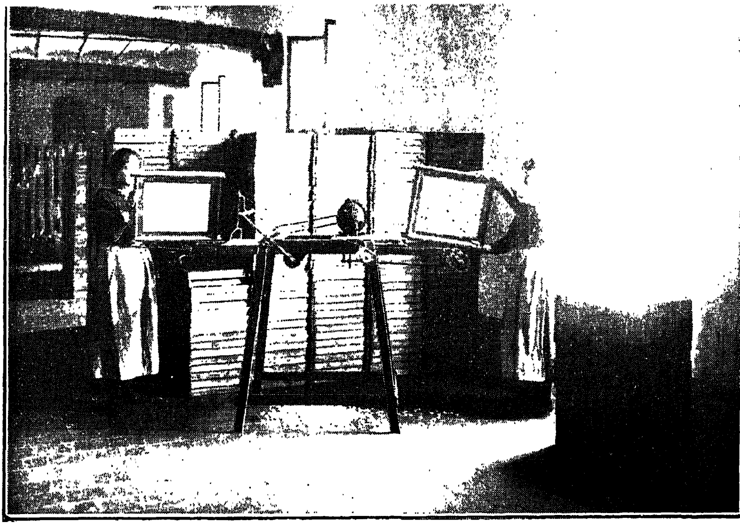
The quality and cost of a flower pomade depend to a very large extent upon the care taken during their production and the cost of labour they have to support.

The manufacturer has always aimed to improve the preparation of pomades made on glass chassis, to diminish the loss of grease, and reduce the manual labour involved, but he has not, until recently, been successful in finding a really practical device. It was therefore necessary to adhere to the process just described, which entailed enormous working expenses.

A few years ago many Grasse manufacturers introduced a process whereby wire, silk, and yarn nets were placed upon the glass frame, between the layer of fat and jasmin flowers, as a perfume absorber. The results were not satisfactory, and this method had to be discontinued.

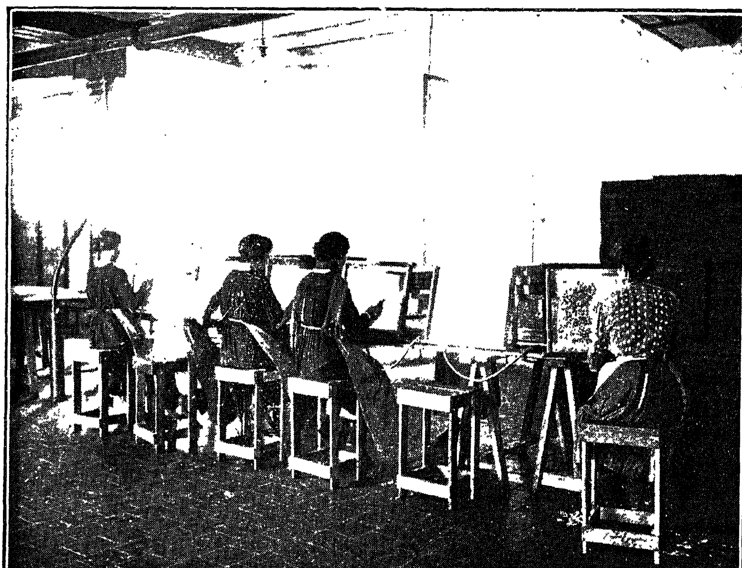
This problem has recently been solved by Messrs. Lautier Fils, who have devised and patented a machine for mechanically removing the flowers, as shown in Fig. 17.

On the right-hand side a woman is seen ready to place on the machine one of the innumerable frames coated with jasmin flowers. This frame is immediately drawn into the apparatus, flower side downwards (towards the rapidly revolving brush), and is seen—two seconds later—on the left-hand side, entirely rid of the flowers, which are blown off and fall to the floor. Two women can pass a quantity of chassis through the machine, the number being increased according to the skill and experience of the operators.



[*Lautier Fils.*

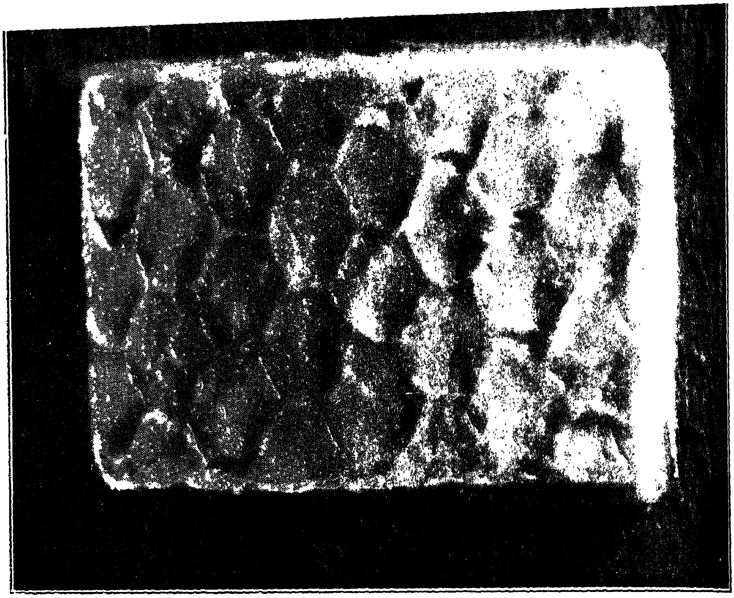
FIG. 17.—Machine for removing Blossoms from Chassis. Note the one on the left after passing over the brush.



[*Lautier Fils.*

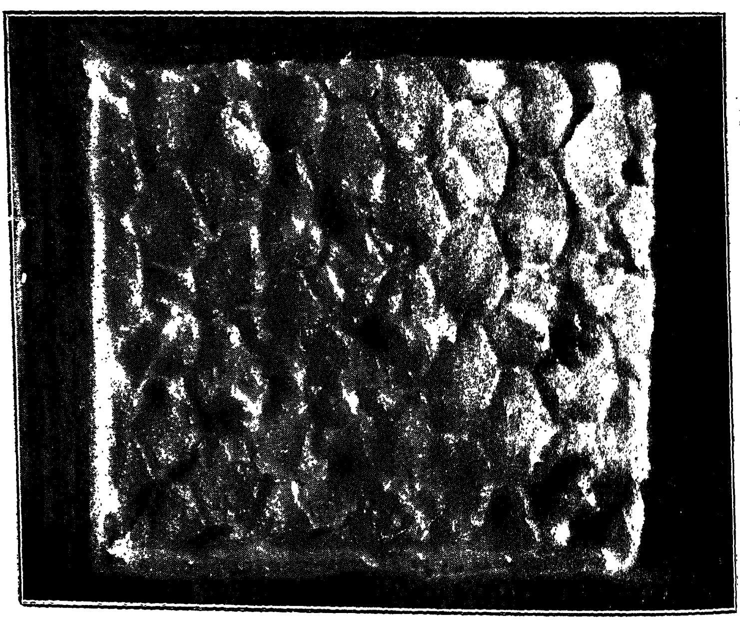
FIG. 18.—Removing Embedded Stalks and parts of Flowers by Vacuum Apparatus.

[To face page 48



[*Lautier Fils.*

FIG. 19.—Section of Chassis Grease from which flowers have been removed by the new method.



The frame seen on the left of the photograph still contains some remnants of flowers, which are too minute to be extracted so rapidly by the machine, regulated so as to "snatch" the flowers as they pass by, without touching the grease coating in any way. The remnants of flowers are removed as shown in Fig. 18.

Four women, seated on the left-hand side, take off the small flower parts by means of a vacuum apparatus, the operation being exceedingly quick and the grease remaining untouched.

The woman seated on the right-hand side is seen removing with her fingers the flowers with which the frame is covered. This is the old-fashioned method already referred to above, where the flowers are removed one by one and any remnants are taken off with either the fingers or small wooden or metallic sticks.

By means of this new invention, the fingers do not come into contact with the fat, as will be seen from Fig. 19.

On the contrary, with the ordinary old-fashioned method, the finger-tips play the chief part, and they leave numerous unavoidable prints shown by the dark spots in Fig. 20, thus producing an irregular surface for the next application of flowers.

The advantages of this new machine method can be easily understood, for the rapidity of working is increased sixfold, and apart from the economy effected, there is absolute cleanliness, minimum loss of grease, and a maximum perfume yield.

A new automatic apparatus for expediting the enfleurage process has been patented by A. Koehler. The flowers fall from a hopper on to a greased conveyor belt running over two cylinders. They remain for a specified time in contact with the fat and are then automatically removed. Messrs. Lautier Fils were granted a similar patent a few months later in 1921.

Occasionally solid fats are replaced with either olive oil or liquid paraffin, in which case cloths are saturated with the liquid and spread on chassis supporting wire frames, instead of glass plates. When the oil is fully charged with perfume, the cloths are removed and submitted to hydraulic pressure. The perfumed oil so obtained is called **Huile Française** or **Huile Antique.** On extraction with one, two, or even three washings of alcohol, these products and the pomades yield the **Extraits** aux **Fleurs**, 1re, 2^{me}, 3^{me}, as the case may be. They are frequently sold as perfumes in this condition and without further treatment. The **Concretes Soluble** are obtained by removal of the alcohol from these *mixed* washings, the process being effected in a vacuum apparatus. In addition to the "absolute" essence, they contain the glycerides of the fatty acids which are soluble in the alcoholic menstruum. The proportion of "absolute" present varies, but as a general rule it is between 20 and 30 per cent of the total weight of "concrete soluble." These products are generally known as **Enfleurage Absolutes.**[1] The fat left behind after the various extractions is known as **Corps Épuisé** and is used in the soap industry.

The flowers removed from the enfleurage greases are not entirely exhausted, and the remaining perfume content is extracted with petroleum ether by the usual methods. These products (of jasmin and tuberose) are known as **Absolute Chassis.** Owing to their slightly fatty smell they are much valued in the preparation of artificial flower oils since this characteristic facilitates the covering of the crude odour associated with most synthetics.

Maceration consists in the extraction of the flowers by immersion in liquid fats or oils at a temperature of about 60° to 70° C. The greases or oils mentioned under enfleurage are used for this purpose, but paraffin appears to find less employment than the others on account of its lower absorption capacity. With the exception of jasmin and tuberose, all flowers, and particularly rose, are treated

[1] Compare also the monograph on Jasmin, and see C. and D. (1928), 308, and "American Perfumer" (1928), 69.

[*Roure-Bertrand Fils.*

FIG. 21.—Manufacture of Pomades by Maceration.

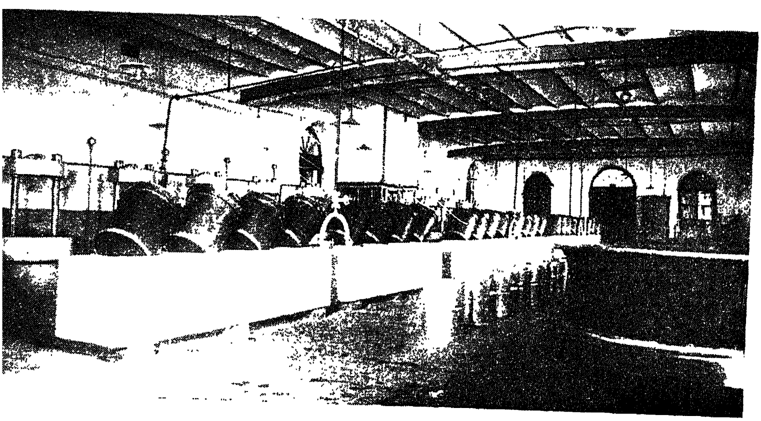


FIG. 22.—Manufacture of Pomades by Maceration. [*Lautier Fils.*

[*To face page* 44.

[*Hydraulic Press Room of Roure-Bertrand Fils.*

FIG. 23.—Manufacture of Pomades by the Hot Process (Maceration).

[*To face page* 45.

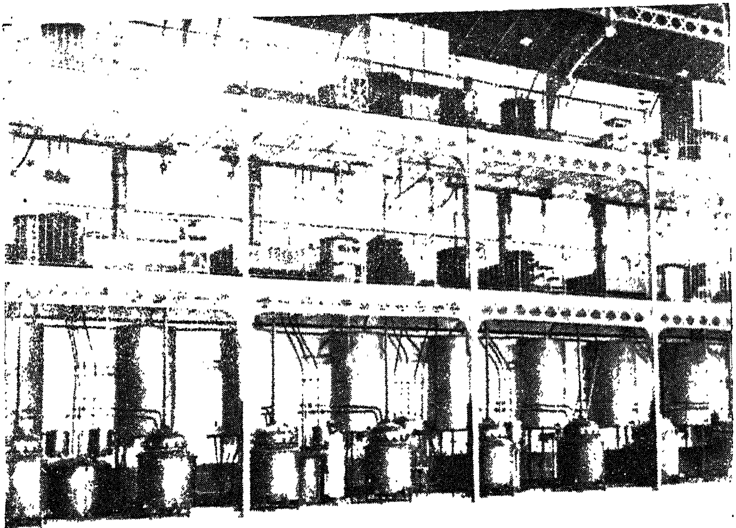
by this process. They are mixed with the hot greases in pans and the whole of the contents stirred for a known period (see Figs. 21 and 22). The cells containing the essential oil are ruptured by the heat and the aromatic constituent absorbed by the fat. When exhaustion is complete the contents of the pan are ejected on to a huge perforated screen and allowed to drain. The fat is collected and further quantities of flowers are mixed in with it, the process being repeated until the extraction media is thoroughly saturated—the exact weight of flowers for the completion of this process having been arrived at by years of experience. The exhausted flowers left on the screen contain quantities of perfumed grease, and they are placed in linen bags and submitted to hydraulic pressure for its recovery (see Fig. 23). Centrifugal apparatus is sometimes used for this purpose.

Volatile Solvents.—This process is of comparatively recent origin and was first experimented with by Robiquet in 1835. He extracted jonquille flowers with ether and obtained a concrete perfume of great delicacy. This method escaped the attention of chemists until 1856 when Millon extracted the perfume from numerous flowers by treatment with various solvents, such as chloroform, benzene, carbon disulphide, methyl and ethyl alcohols, etc. The yields were of good quality and the process was tried commercially, but owing to the loss of solvent it never paid and was discontinued. In 1879 Naudin patented a closed apparatus which eliminated these losses, and with the advent of petroleum light fractions the process offered commercial possibilities, but it was not until about 1890 that its real application on an industrial scale was attempted. Several solvents have been tried such as benzene, carbon disulphide, etc., but for various reasons they have been discarded, and the one in most general use at the present time is petroleum ether, sp. gr. 0·650 (15° C.). This is first purified by treatment with sulphuric acid and alkali and subsequently rectified. Recently benzole has come into prominence because in the case of jasmin and rose a higher (and consequently cheaper) yield is obtained. The extractors resemble a battery of percolators (see Fig. 24), each having a capacity up to 100 gallons and fitted with several trays or perforated cylinders, in which the flowers are placed. The vessels are hermetically sealed (see Fig. 26), and connected the one with the other by means of tubes. At one end of the series they connect with the solvent tank and at the other with a vacuum still. The solvent runs through slowly and, when it reaches the vacuum still, is distilled off and returned to the solvent tank. The perfume remains behind in the retort. The solvent continues to pass through the apparatus until the flowers in each unit are exhausted in turn. They are then replaced without interfering with the continuity of the process. The product left behind in the retort is solid or nearly so. It contains the odoriferous materials together with the natural and insoluble plant waxes, and is known as Concrete (*parfum naturel solide*). Twenty-five grams of this extractive represents about one kilo of pomade No. 36. The yield per cent of flowers (weight) is as follows for the cases cited :—

Cassie	about 0·4 per cent.
Jasmin	,, 0·3 ,,
Rose	,, 0·24 ,,
Violet	,, 0·15 ,,
Orange blossom . . .	,, 0·282 ,,
Mignonette . . .	,, 0·14 ,,

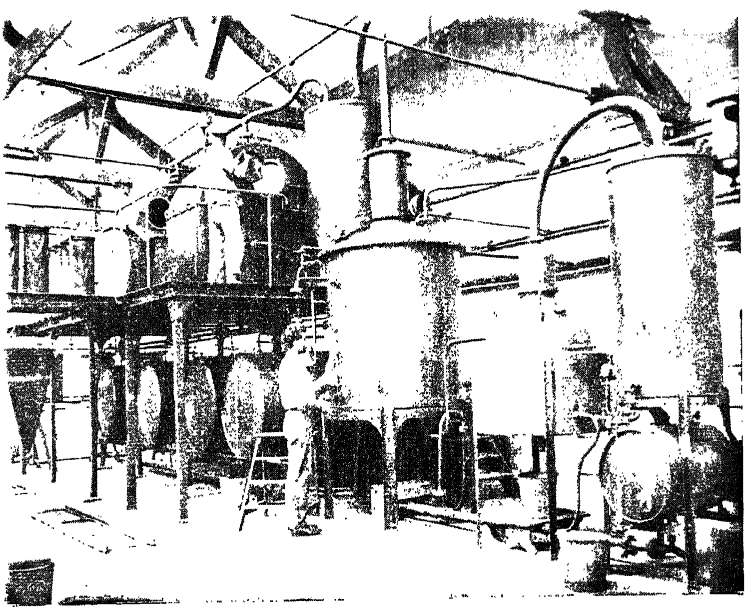
In working the above process it is customary to treat the flowers as received from the fields. Messrs. Lautier Fils have found, however, that by subjecting them to high pressure before treatment with volatile solvents, the yield of concrete is greatly increased.

The explanation given by them of this enhanced yield is, that the high pressure causes the cells to burst, thus allowing the glucoside and diastase to react more freely with the production of a greater amount of essence.



[*Roure-Bertrand Fils.*

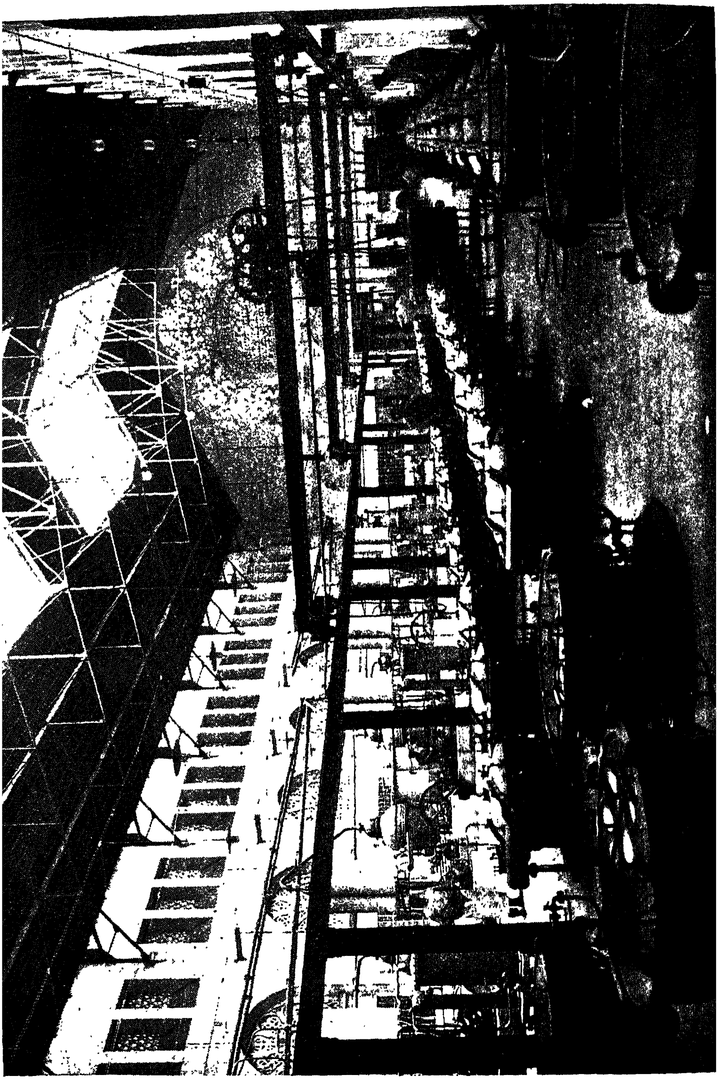
FIG. 24.—Extraction Plant (Volatile Solvents).



[*Pilar Freres.*

FIG. 25.—Extraction with Volatile Solvents.

[*To face page* 46.



Another apparatus for the extraction of various odoriferous substances has been patented by J. A. Hugues. In general structure it resembles a dredging machine. Two endless chains carry perforated boxes containing the flowers or substance to be extracted. One box at a time passes through the solvent, the whole being enclosed. When the solvent has become saturated, it is run off and separated in a vacuum still. The solvent remaining in the boxes is recovered by steam distillation.

Messrs. Lautier Fils have patented the extraction method which necessitates the prior elimination of water from the flowers, etc., by the use of hygroscopic substances such as anhydrous sodium sulphate, etc.

In order to remove the plant waxes, the *concrete oils* are shaken with strong alcohol for twenty-four hours in machines called "Batteuse" (see Fig. 27), and the *insoluble* waxes removed by filtration. The alcoholic filtrate contains small quantities of *soluble* waxes, which are separated by freezing at about 20 degrees below zero. The **Absolute** flower oil[1] is obtained from this dewaxed alcoholic solution, either by the removal of the solvent *in vacuo* or by the addition of salt, when the odoriferous essence separates on the surface and is collected. Standardised natural liquid absolutes are prepared from these essences by the addition of a neutral solvent and are completely soluble in alcohol. The yield of absolute flower oil (super-essence or specially purified) and of concrete by the volatile solvent process has been recorded by Y. R. Naves,[2] who obtained the following results, shown on page 48, in the Laboratories of Messrs. Antoine Chiris.

In a number of cases the absolute flower oil contains varying quantities of colouring matter, which depends upon the volatile solvent used for extracting the flower. The presence of these pigments is not always desirable when

[1] For the preparation of absolute chassis consult the monograph on Enfleurage in this chapter.

[2] "Die Riechstoffindustrie," xii., 26.

highly concentrated perfumes are being prepared, as they are liable to colour the handkerchief or dress to which they may be applied. In consequence, so-called **Colourless Absolutes** are in many instances manufactured, the separation of a portion of the pigment being effected either by steam distillation *in vacuo*, by co-distillation with ethylene

	Percentage Yield of	
	Concrete.	Absolute from Concrete.
Acacia	0·15-0·2	35-40
Broom	0·1-0·18	30-40
Carnation	0·2-0·25	9-12
Cassie—ancient	0·3-0·4	33
„ Roman	0·35-0·5	33
Champaca	0·16-0·2	50
Gardenia	0·04-0·05	50
Hyacinth	0·9-1·05	60-70
Immortelle	0·6-0·95	45-50
Jasmin	0·15-0·2	10-14
Jonquille	0·28-0·33	45-53
Mimosa	0·3-0·55	40-55
Narcissus	0·25-0·45	27-32
Orange Blossom	0·2-0·4	36-55
Rose—Bulgarian	0·22-0·25	50-60
„ French	0·17-0·25	55-65
Tuberose	0·08-0·1	18-23
Violet—Parma	0·07-0·12	35-40
„ Victoria	0·08-0·18	35-40
Ylang-ylang	0·8-0·95	75-80

glycol, or by exposure of the product to ultra-violet light rays. In the majority of cases, however, these products cannot be said to be *completely* colourless.

The following table shows the approximate weight of *absolute flower oil* that is required to produce one thousand of the type of perfume or cosmetic indicated :—

[*Roure-Bertrand Fils.*

FIG. 27.—Batteuses for Washing Pomades.

[*To face page* 48.

	Strength of Alcohol.						
	90 per Cent.	80 per Cent.	70 per Cent.	60 per Cent.	50 per Cent.	40 per Cent.	30 per Cent.
Extract No. 72	25	—	—	—	—	—	—
Extract quadruple No. 36	22	20	18	12	—	—	—
Extract triple No. 24	15	13	11	9	7	—	—
Toilet waters	5	4·5	4	3	2	1·5	1
Toilet creams	up to 5						
Toilet powders	up to 10						
Hair preparations	up to 8						

Note.—These quantities are also applicable to *synthetics and terpeneless essential oils.*

Absolutes with Synthetics.—This process evolved by E. Charabot is covered by French patent 717,445. It permits the flower itself to complete a perfume mixture by keeping the latter in contact with the flower during the extraction of the natural perfume.

For instance, a lilac perfume is prepared as follows: the wax obtained by the extraction of jasmin flowers is added to a good quality lilac compound until the mixture has the consistency of enfleurage grease. The chassis are coated with this grease in the usual manner and then lilac flowers added, these being renewed daily in accordance with the standard methods of enfleurage. The flowers removed from the chassis are extracted and subsequently also the enfleurage fats. The two extracts are mixed and the absolute prepared by the usual methods.

Absorption.—A process has been patented by I.G. Farben-industrie Aktiengesellschaft for the absorption of flower perfumes by carbon or silica gel, the perfume being afterwards recovered by suitable methods. Whether this process has been successfully applied industrially is not yet known.

Extraction with Liquid CO_2.—A German process has recently been patented in which it is claimed essential oils can be completely extracted without, in any way, impairing the odour of the natural product. The advantages are low temperature, quantitative yield, complete and spontaneous evaporation of the solvent from the extract.

STATISTICS.

Flower Consumption.—The average consumption of flowers at Grasse for the ten years 1913-1923 was as follows :—

Orange blossoms .	2,200 tons
Roses . . .	1,650
Jasmin . . .	1,320
Mimosa branches .	880
Violets . . .	440
Tuberoses . .	330
Carnations . .	165
Cassie . . .	110
Reseda . . .	66
Narcissus . .	55

In the Department of Var there are approximately 7500 acres of ground devoted to the cultivation of flowers for perfumery. Of this area, about one-tenth is set apart for the growth of 30 million jasmin plants yielding the above weight of blossoms. The crop of 45 bitter orange trees, *i.e.* about half a million blossoms weighing 1000 pounds, yield one pound of neroli oil.

The relative importance of the foregoing processes in the treatment of flowers is approximately as follows :—

Flowers.	Distillation.	Enfleurage and Maceration.	Volatile Solvents.
Carnation	—	—	100
Cassie	—	20	80
Clary sage	95	—	5
Hyacinth	—	—	100
Jasmin	—	10	90
Jonquille	—	10	90
Mimosa	—	—	100
Narcissus	—	—	100
Orange blossom	10	10	80
Reseda	—	10	90
Rose	10	10	80
Tuberose	—	50	50
Violet	—	20	80

Production Seasons.—

Name.	Principal Districts of Cultivation.	When Picked.
Cassie	Cannes, Vallauris	September
Clary sage	Var, Vaucluse	June-July
Geranium	Grasse, Pegomas	October
Jasmin	Grasse, Pegomas, Mouans-Sartoux	July-October
Lavender	Alpes Maritime, Basses-Alpes, Vaucluse	July-September
Mimosa	Alpes Maritime, Var, Riviera	December-February
Orange blossom	Cannes, Le Cannet, Golfe Juan, Antibes	April-May
Peppermint	Pegomas, Villeneuve, Loubet	July-September
Roses	Grasse, La Colle, St. Paul, Vence, Le Bar	April-May
Rosemary	Gard, Hainault	September
Sage	Grasse-Montaraux	July-August
Spike	Riviera	August
Thyme	Riviera	April-June and October
Tuberose	Pegomas, Mouans-Sartoux	July-October

Yields per 100 Kilos.—

Raw Material.	Gra		
Almonds, bitter	220	to	240
Aniseed	1,600	,,	2,000
Bergamot	600	,,	700
Cassie	800	,,	850
Cinnamon bark	450	,,	1,800
Clary sage	50	,,	60
Cloves	16,000	,,	18,000
Geranium	100	,,	130
Laurel leaves	700	,,	850
Lavender	800	,,	1,100
Mimosa	700	,,	800
Mint (fresh)	700	,,	720
Mint (dried)	2,100	,,	2,800
Myrtle	250	,,	300
Orange blossoms	700	,,	1,500
Orange peel	300	,,	350
Origanum	500	,,	760
Rose	50	,,	80
Rosemary	500	,,	550
Spike	500	,,	1,000
Thyme	80	,,	120
Violet	3	,,	4

The above figures must be taken as very approximate, since variations in flowers occur due to climate and soil.

French Oil Imports.—

Source.		Per Cent.
Dutch East Indies and Italy	each	15
Spain		7
Great Britain, India and Japan	,,	6
United States		3
Netherlands and Uruquay	,,	2
Other countries		38
		100

IMPORTS OF ESSENTIAL OILS INTO FRANCE.

	1928.	1929.	1930.	1928.	1929.	1930.
Essential oil of	kilos	kilos	kilos	1,000 francs	1,000 francs	1,000 francs
Rose . . .	2,206	2,308	1,114	27,554	29,148	20,399
Geranium . .	23,359	14,627	13,088	3,756	2,603	1,858
Ylang-ylang . .	24,105	32,783	15,982	9,989	11,166	3,263
Lemon, bergamot, orange, mandarin	105,153	249,646	230,675	23,959	33,524	16,665
All other . .	1,253,340	1,210,242	1,118,319	87,264	82,978	62,863
Terpeneless . .	12,793	7,799	19,099	844	524	907
Total . .	1,420,956	1,517,405	1,398,277	153,366	159,943	105,955

EXPORTS OF ESSENTIAL OILS FROM FRANCE.

	1928.	1929.	1930.	1928.	1929.	1930.
Essential oil of	kilos	kilos	kilos	1,000 francs	1,000 francs	1,000 francs
Rose . . .	1,062	1,618	1,424	4,544	6,695	4,133
Geranium . .	7,401	24,674	21,774	972	3,033	3,255
Ylang-ylang. .	9,980	13,058	10,974	2,097	3,381	1,807
Lemon, bergamot, orange, mandarin	33,792	26,318	30,956	2,038	1,969	2,678
All other :—						
Great Britain .	218,841	164,760	175,325			
Germany . .	96,219	90,918	89,463			
Switzerland .	56,958	55,764	47,897			
Japan . .	103,318	81,761	91,612			
United States .	218,583	295,110	326,720			
Other countries .	400,912	413,708	325,642	103,978	85,624	75,552
Terpeneless . .	1,132	1,566	3,319	130	194	462
Total . .	1,148,198	1,169,255	1,125,106	113,759	100,896	87,887

CHAPTER III.

THE PURCHASE AND USE OF FLOWER ABSOLUTES.

1. How to buy.
2. Manufacturers' raw materials.
3. Dilutions and pure absolutes.
4. Testing the odour.
5. Suggested standards for sale.
6. Qualities in artificial flower oils.
7. Use of absolutes in perfumes, face powders, and vanishing creams.

When you buy flower absolutes, do you ask for an ordinary quotation?

If you do and want the best product, then you are making a mistake.

This statement on first sight may seem a little abnormal, especially so to keen buyers—and they exist in the perfumery trade. But in actual fact, as I shall endeavour to prove, this assertion will bear the closest inspection.

Rose and jasmin absolutes are the two flower products which sell big—the others, tuberose and orange blossom, have a smaller circle of users—while mimosa, cassie, etc., are only used by those chemists who have experimented widely and found how to employ them very advantageously.

A flower absolute in the strict sense of the term means the whole of the perfume element in the flower (as far as it can be extracted) without natural waxes, pigments, etc. The volatile solvent process as is well known is universally adopted by the manufacturers of flower absolutes, and very probably over 90 per cent of them are produced by this method. The others (enfleurage absolutes) are (in a small percentage of cases of jasmin and tuberose) obtained by extracting the enfleurage pomade and in certain cases are to be preferred. The former, however, are generally asked for by buyers who know what they expect to get, so that for the purpose of quotations they are, more or less, obtaining a standard product prepared by a standard process.

It is necessary now to look a little farther back and examine the question of raw materials. It is customary for the flower growers to arrange the price of flowers before the crop is collected, and providing a reasonably good yield is anticipated after a normal season the different manufacturers pay the same price. If on the contrary atmospheric conditions have been such that a poor yield is anticipated, then it is often found that in spite of pre-arranged prices some speculator steps in and buys up as much of the crop as he can at a figure in excess of that agreed upon. Such instances come up now and again when there is naturally a slight variation in the cost of the finished absolute, but keen buyers observe these fluctuations which are recorded in the Grasse reports published in the Perfumery Press, and bear them in mind when making a purchase. When the crop is normal, however, no such fluctuations occur, but there is another aspect of the case which requires to be considered. Many of the larger firms grow a proportion of their more important raw materials. As progressive concerns they naturally study the question of soil, manure, situation, etc., with a view to obtaining blossoms rich in perfume and in consequence of high yield. It would, however, be absurd to assume that any one company has succeeded in consistently obtaining a better product and a higher yield than all other firms for every one of the flowers used by them in the production of absolutes. It can therefore be reasonably assumed that from the point of view of yield, all makers are using flowers which so nearly approximate that they may be considered to be of standard quality.

Having therefore agreed that the raw materials and process approximate so closely as to be identical, how is it possible to obtain any one flower absolute from two sources of supply—the one at sometimes double the price of the other? It is of course common knowledge that odourless or nearly odourless solvents, such as ethyl phthalate, benzyl benzoate, amyl benzoate, etc., are used as diluents, while some firms employ alcohol. Providing these dilutions are made clear to the purchaser no complaint can be made, but it is obviously wrong to send out dilutions described as absolutes. Manufacturers do not do this from choice but simply to meet competition—so called. To overcome this difficulty some makers have recently prefixed their description by "perfect" or "prima," denoting the fact that the absolute is pure—but of course the price is always high, which frightens some short-sighted buyers. It is more economical in the end to buy the purest obtainable, even if it is the dearest, and to make the dilution oneself.

When buying absolutes therefore ask your different agents to submit samples and prices for guaranteed pure absolutes. Insist on the fact that purity is essential and price of secondary consideration.

There will of course be differences, but not big ones, between the prices submitted; with the guarantee above desired, these variations in price can be attributed to the fact that one maker is satisfied with a smaller margin of profit than another.

The difficulty next presents itself of which of the guaranteed pure absolutes to buy. The final test is of course that of odour. These delicate flower products are extremely unsatisfactory to judge in concentrated form, and a 1 per cent dilution in alcohol should therefore be made of each sample. On being left for a week and then a known number of drops placed on an odourless absorbent strip of paper a much better comparison can be made. Should there be any doubt between say two of the samples, it is more conclusive to make up specimens of the perfume for which the samples are intended and then make a comparison after maturing.

It seems, therefore, very desirable that the makers of absolutes should get together and for their own protection arrive at some definite arrangement concerning the marketing of these products. It would help buyers if only two standards of each odour prepared by the volatile solvent process were listed.

1. Absolute flower oil—guaranteed.
2. 10 per cent flower oil.

This would enable the small user of the expensive oil to make his purchase and know what he is getting. Whereas now he does, in fact, buy a dilution to get his price down, but he does not know the strength of that dilution, and often when he thinks he is buying cheaper, is merely getting a weaker solution.

The amount of business transacted in artificial flower oils of good quality is considerable. The main difference between these and those of indifferent quality is that the former contain flower absolutes in fairly large proportion and the latter either an insignificant quantity or often none at all. It may be assumed, therefore, that in buying artificial flower oils the price paid is generally according to quality and varies according to the percentage of natural perfume contained. In compounding these flower oils the aim of the chemist is always to approximate as closely as possible the characteristic flower odour without the natural perfume. Even though he may succeed in getting a fairly accurate reproduction of the odour with the skilful use of essential oils, synthetics, natural isolates, and in particular higher fatty aldehydes, there is always the smooth softness of the flower lacking. The pure flower absolute here supplies the missing link. It covers up those imperfections of odour as no other, at present known, substance. The more skilled the artist the less flower absolute he uses to obtain that soft finished otto.

There are several points in connection with the manufacture of artificial flower oils which must be borne in mind by the seeker after perfection. For instance, the percentage of flower absolute necessary is influenced by the ratio to one another of essential oil, terpeneless essential oil, natural isolate and synthetic used in imitating the flower odour note. It naturally follows that by using terpeneless oils the concentration and power of the resulting artificial oil is enhanced. Further, a terpeneless oil is generally preferable to a natural isolate, because by reason of the minute traces of known and also unidentified esters, ketones, aldehydes, etc., always present in the former, it has a softer odour note. Synthetics, on the other hand, are generally comparatively coarse in odour, but they can be softened appreciably by the addition of traces of clary sage oil or concrete. The odour notes of these two products differ—the former is more powerful and will go farther in consequence. The latter has a distinct resemblance to that of amber. All the higher fatty aldehydes from C_8 to C_{13} have an extensive use in finishing off artificial flower oils. The choice of the right member of the series is imperative, and great care is necessary so that an excess is not added. Too much fatty aldehyde will soon ruin any flower oil.

With the possible exception of jasmin and tuberose, the flower absolutes prepared by the volatile solvent process are used up to whatever percentage price will allow, and they yield excellent results. In the case of jasmin and tuberose, however, many chemists will have found distinct advantage with the use of enfleurage absolute. This is prepared by extracting jasmin pomade with petroleum ether. The absolute thus prepared has a more fatty odour than that prepared by the ordinary process, and in the production of the finished otto this shade of odour assists in covering the rough edges of the synthetics more effectively than the other. Having selected the best raw materials and blended them in the requisite proportions, the final softening of the artificial flower oil may be hastened by refluxing the whole at a warm temperature, using a water-bath as the source of heat.

In the production of alcoholic perfumes the soft odour note in all the best products is due to a liberal use of flower absolutes. One of the reasons why well-known perfumes of English and French manufacture are so popular is that the makers use plenty of natural and comparatively little of synthetics; the latter are used to obtain the distinctive note and the former to enhance the bouquet.

In the preparation of face powders the perfume is in nearly all cases the real selling feature (especially the first sale). Flower absolutes used alone to perfume these products are an entire failure. Although the constituents of the powder are themselves odourless, they seem to alter the softness of the flower note and give it an odour which cannot be described better than of an "acid" nature. It is more than ever necessary in these products therefore to give the powder a warm soft fragrance as a basis on which to build the finished perfume. For this purpose the following substances are useful in the proportions indicated :—

Heliotropin	18
Coumarin	5
Vanillin	2
Musk ambrette	5

The odour is then built up with essential oils and synthetics and the flower absolutes added to yield a soft elusive fragrance.

Many vanishing creams placed on the market are perfumed with essential oils and synthetics only. When flower absolutes are used, great care must be exercised to ensure that the correct ones are chosen, otherwise discoloration of the cream results. The two which must be avoided are jasmin and orange blossom. These contain indole, and although the proportion of absolute may be infinitesimal the cream nevertheless soon assumes a yellowish-grey appearance, and if exposed to sunlight this becomes reddish. When the jasmin odour is desired it is always safer to use rose absolute and benzyl acetate, this combination having a similar effect in a compounded otto. In the case of orange blossom, it is advisable to employ rose absolute and terpeneless French petitgrain oil.

In conclusion it must be remembered that the use of flower absolute to the limit allowed by costs will always repay the manufacturer. To economise on perfume is a short-sighted policy, and its results will soon be reflected in the monthly sales record of any firm adopting this method of cutting down costs.

CHAPTER IV.

ODOUR CLASSIFICATION.

1. Rimmel.
2. Piesse.
3. Crocker and Henderson.

THE classification of odours as a means of offering some assistance to the creative perfumer does not appear to have been placed, so far, upon a really practical basis. Before the introduction of synthetics this problem was not quite such a difficult one, because the perfumer had at his command only the commoner essential oils and flower extracts.

Chemistry has evolved not only numerous shades of each odour type, but it has also created entirely new perfume bases. Moreover, many more essential oils are now available, and the whole gamut consists of perhaps a thousand raw materials against a former fifth of that number.

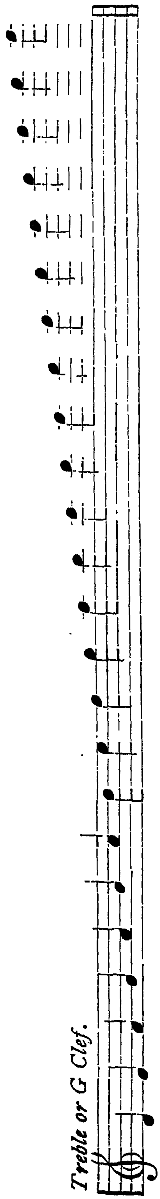
Rimmel in concluding his Book of Perfumes endeavoured to classify the then known substances by adopting a type for each class of odours and grouping with them other materials of similar fragrance. He was able to reduce his classification to eighteen distinct types which are given on p. 61.

Piesse in his art of perfumery took quite a different view of classification and compared odours with sounds. Scents, like sounds, he says, appear to influence the olfactory nerves in certain definite degrees. There is, as it were, an octave of odours like an octave in music; certain odours coincide, like the keys of an instrument. Such as almond, heliotrope, vanilla, and clematis blend together, each producing different degrees of a nearly similar impression. Again there are citron, lemon, orange peel, and verbena

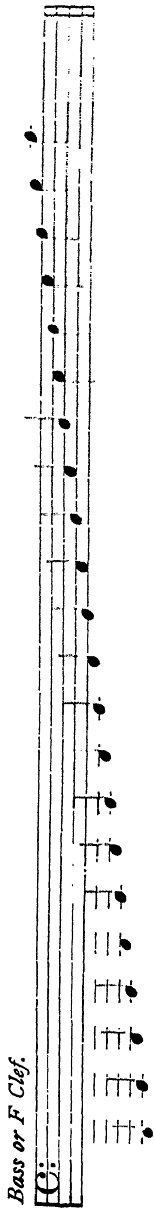
Classes.	Types.	Odours Belonging to the Same Class.
Almondy	Bitter almond	Laurels, peach kernels, mirbane.
Amber	Ambergris	Oakmoss.
Anise	Aniseed	Badiane, caraway, dill, fennel, coriander.
Balsamic	Vanilla	Peru, tolu, benzoin, styrax, tonka.
Camphoraceous	Camphor	Rosemary, patchouli.
Caryophyllaceous	Clove	Carnation, clove pink.
Citrine	Lemon	Bergamot, orange, cedrat, limes.
Fruity	Pear	Apple, pineapple, quince.
Jasmin	Jasmin	Lily of the valley.
Lavender	Lavender	Spike, thyme, serpolet, marjoram.
Minty	Peppermint	Spearmint, balm, rue, sage.
Musky	Musk	Civet, ambrette seed, musk plant.
Orange flower	Neroli	Acacia, syringa, orange leaves.
Rosaceous	Rose	Geranium, sweetbrier, rhodium rosewood.
Sandal	Sandalwood	Vetivert, cedarwood.
Spicy	Cinnamon	Cassia, nutmeg, mace, pimento.
Tuberose	Tuberose	Lily, jonquil, narcissus, hyacinth.
Violet	Violet	Cassie, orris-root, mignonette.

forming a higher octave of smells, which blend in a similar manner. The analogy is completed by what are called semi-odours, such as rose and rose-geranium for the half-note; petitgrain, neroli, a black key followed by fleur d'orange. Then there are patchouli, sandalwood, and vetivert, and many others running into each other. In the following gamut, Piesse endeavoured to place the name of the odour in its position corresponding to its effect on his olfactory sense. If a perfumer desires to make a bouquet from primitive odours, he must take such odours as chord together; the perfume will then be harmonious. In passing the eye down the gamut it will be seen what is a harmony and what is a discord of smells. As an artist would blend his colours, so must a perfumer blend his scents.

The Gamut of Odours as arranged by Piesse.



F	Civet.
E	Verbena.
D	Citronella.
C	Pineapple.
B	Peppermint.
A	Lavender.
G	Magnolia.
F	Ambergris.
E	Cedrat.
D	Bergamot.
C	Jasmin.
B	Mint.
A	Tonquin Bean.
G	Syringa.
F	Jonquille.
E	Portugal.
D	Almond.
C	Camphor.
B	Southernwood.
A	New Mown Hay.
G	Orange Flower.
F	Tuberose.
E	Acacia.
D	Violet.



C	Rose.
B	Cinnamon.
A	Tolu.
G	Sweet Pea.
F	Musk.
E	Orris.
D	Heliotrope.
C	Geranium.
B	Stocks and Pinks
A	Peru Balsam.
G	Pergaloria.
F	Castor.
E	Calamus.
D	Clematis.
C	Santal.
B	Clove.
A	Storax.
G	Frangipanni.
F	Benzoin.
E	Wallflower.
D	Vanilla.
C	Patchouli.

Crocker and Henderson[1] have made an analysis and classification of odours on a numerical basis. In their investigation they attempted to find the elements of sensation which make up all odours and came to the conclusion there are four kinds only. According to this point of view there are four types of olfactory nerves which are stimulated to differing degrees by the various chemical excitants which we call stinks, scents, or perfumes. These four apparently elementary odour sensations are :—

1. *Fragrant* or sweet.
2. *Acid* or sour.
3. *Burnt* or empyreumatic.
4. *Caprylic* or œnanthic.

These chemists arranged several hundred pure chemicals and some essential oils, according to the relative amounts of each odour component. To each component they assigned a figure or coefficient which noted the intensity of that component, as compared with a set of standards more or less arbitrarily assembled. They found it possible to easily note eight degrees and zero for each component.

The sensation "fragrant" is prominent in the sweetness of flowers, in musk and violet ketones, and is noticeable in salicylates and cinnamates. It is practically absent in formic acid to which these chemists assigned the value 0. A moderate amount is noticeable in isopropyl alcohol to which they assigned the value 3 ; decidedly sweet are citronellol and geraniol which they value at 6 ; and even more so iso-amyl and iso-butyl salicylates to which they gave the value 7 : animal musk and some of the violet ketones are extremely sweet and were thus valued at 8.

The sensation "acid" is that component of acetic and formic acids and sulphur dioxide which gives sharpness to the odour and which is popularly recognised as "vinegary" or "sour." That it has remote connection with chemical acidity is indicated by its prominence in citral, camphor, acetone, and a number of other chemically neutral materials.

[1] "American Perfumer" (1927), 325.

"Burnt" odour is well characterised and easily detected, for instance geraniol 2; citral 4; bornyl acetate 5; skatol 7.

"Caprylic" is a generally unpleasant sensation when strong, yet much missed when nearly absent. It is present in very small amount in good absolute alcohol, but in large amount in fusel oil.

Some of the standards adopted by Henderson and Crocker are as follows:—

Fragrant.

5222. Phenylethyl benzoate.
6434. Diphenyl ether.
7343. Safrole.
8445. Benzyl acetate.

Burnt.

5414. Normal propyl alcohol.
6322. Phenyl propyl alcohol.
4376. Para-cresyl acetate.
7584. Guaiacol.

Acid.

6123. Beta-naphthyl ethyl ether.
5523. Iso-butyl phenylacetate.
5636. Methyl phenylacetate.
5726. Cineole.

Caprylic.

5221. Santalol.
5322. Iso-amyl benzoate.
2424. Toluene.
2377. Anisol.

The method which these chemists used in assigning odour numbers was to smell for but one component at a time. The following table gives the numerical limits of what can be easily recognised as the particular indicated type of odour:—

Type.	Fragrant.	Acid.	Burnt.	Caprylic.
Perfume . . .	6-8	2-6	2-4	2-4
Lilac . . .	7	4	3-4	3-4
Jasmin . . .	6	3	3-4	3-4
Orange . . .	6-8	5-7	1-3	2-4
Lemony . . .	6-8	6-8	1-2	4-7
Spicy . . .	3-8	4-7	any	2-6
Rose-like . . .	5-7	4-6	2-3	3-5
Tea-like . . .	4-6	0-4	1-3	1-5
Fruity . . .	4-8	5-8	0-2	4-7
Mushroom-like . .	4-6	3-6	3	4-5
Musty . . .	4-6	4-7	3-5	4-7
Sweet herb . .	4-8	4-7	any	5-8
Rank herb . .	1-3	4-7	1-5	5-8
Rum-like . . .	4-6	5-8	0-2	5-8
Piney . . .	4-6	5-7	any	3-6
Camphoric . .	4-6	5-7	4	3-6
Putrid . . .	4-6	5-8	any	7-8
Greasy . . .	3-5	6-7	5-7	5-7
Garlic and onion .	3-5	6-8	3-5	7-8
Metallic . . .	0-4	5-7	0-2	5-8
Tarry . . .	any	any	7-8	6-8

All these classifications of odour are of little practical value to the research perfumer because it is by new combinations of raw materials that he is able to create new and artistic bouquets. In 1926, the author undertook, for his own use, a classification on the basis of the duration of evaporation, and this work was not completed until 1930. He found that the boiling-points of raw materials could not be taken as the true indication of their actual lasting power although such a list appears in the S.P.C. Cyclopædia. Moreover, his investigation revealed an entirely new aspect of the problem of fixation, so that the publication of this work must be deferred, for various well-appreciated reasons, until some future date.

CHAPTER V.

FIXATION AND BLENDING.

1. Introduction, pre-fixation, blending, final fixation.
2. Natural fixators—animal, vegetable (including essential oils, balsams, gums, and oleo-resins).
3. Artificial fixators—synthetic aromatic chemicals, compounds (including ambers, floral fixators, oriental fixators, and toilet water fixators) with formulæ.
4. Classification of fixators—(1) essential oils, (2) balsams, gums, and oleo-resins, (3) synthetic aromatic chemicals, (4) odourless synthetics.
5. Flower perfume fixators—classified and tabulated list of the more important floral odours with wide range of suitable fixators.

Fixation is *the* question of utmost importance in the manufacture of perfumes, and the demands of the public for bouquets that will "hold" has made this subject one of continuous study for the chemist. It is a curious thing that although the ancient Egyptians and Grecians had few materials and no technical knowledge such as we possess to-day, yet they were able to make perfumes of lasting fragrance. This has been recently demonstrated by the discoveries in the tomb of Tutankhamen. The tenacity of a perfume was esteemed in those days, as will be clear on referring to the works of Theophrastus (370 B.C.). Concerning odours he says: "Those perfumes whose scent is strongest get the best hold on the skin, head, and other parts of the body, and last the longest time: such are *megaleion*, Egyptian perfume, and sweet marjoram perfume. Those, on the other hand, which are weak and have not a powerful scent, since they are volatile and evaporate, also quickly come to an end: for instance, rose perfume and *kypros*. There are some, however, whose scent is even better on the second day, when any heavy quality that they possessed has evaporated. Some again are altogether more permanent, as spikenard and iris-perfume, and the stronger a perfume is the longer it lasts." The same writer also refers to the properties of certain perfumes as follows: "The lightest are rose-perfume and *kypros*, which seem to be the best suited to men, as also is lily perfume. The best for women are myrrh-oil, *megaleion*, the Egyptian, sweet marjoram, and spikenard: for these, owing to their strength and substantial character, do not easily evaporate and are not easily made to disperse, and *a lasting perfume is what women require*." There are a few chapters in Pliny's works which treat of perfumes and unguents, but he does not appear to have had such a clear idea of fixation as Theophrastus although he lived some 400 years later and presumably in a more enlightened age. In that part of his work quoted in Chapter 1, dealing with the Roman era, he speaks of resin and gum as fixators, and yet in Book XIII, Chapter 4, he says "unguents lose their odour in an instant, and die away the very hour they are used. The very highest recommendation of them is, that when a female passes by, the odour which proceeds from her may possibly attract the attention of those even who till then are intent upon something else . . . for the person who carries the perfume about with him is not the one, after all, who smells it." The fixative properties as a pre-requisite of a good perfume were appreciated still more at a later date, which is proved by the "Parfum à la Maréchale," made from the formula of Dejeans. This creation was in vogue in the eighteenth century on account of its fragrance *and persistence*. The original recipe for the "Poudre à la Maréchale" (1777) was as follows:—[1]

Take—

4 oz. of ambrette.
4 ,, ,, clove wood.
4 ,, ,, coustadon.
2 ,, ,, calamus.
2 ,, ,, Florentine iris.
1 ,, ,, cloves.
1 ,, ,, dill seeds.
1 ,, ,, dried lemon peel.
1 ,, ,, dried orange flowers.
1 grain of ambergris.

[1] "Traité des Odeurs," from a new edition (1788).

Crush these things partly and pass through a sieve of silk. Repeat the operation until the whole has passed. Then put your powder in a bottle, etc. The extract was produced from these materials in later years by maceration in alcohol, and *it is noticeable that no mention was made of distillation.*

To-day the public insist on *every* perfume being tenacious, and the longer it will remain fragrant after the evaporation of the alcohol, the more popular becomes the perfume. Even in the case of eau-de-Cologne, which at one time was required to be sweet and elusive, it is noticeable that a large number of users have shown a distinct inclination towards a toilet water of persistence, and in consequence perfumers have introduced amber Colognes, mimosa Colognes, etc. These perfumes bear very little relation in odour value to the original, but for tenacity they far excel it. Distillation has been referred to in the case of the extract à la maréchale, and had this process been applied, the persistence of the perfume would have suffered, although some of its fragrant constituents would have passed over with the alcohol. This analogy can be applied to almost any perfume, and it clearly shows that the volatile portions must be fixed by other less evanescent bodies. This, then, would indicate that the art of fixation lies in being able to select those substances which, when blended with the more volatile constituents of a perfume, will prevent their rapid evaporation and at the same time retain the predominating note of their fragrance, or put in another way —will equalise the different rates of evaporation of the various constituents. The group of bodies from which suitable fixatives for any perfume may be selected is a large one, and their odours may be classified under three headings :—

(*a*) *Pleasantly aromatic*, such as benzoin, olibanum, tolu, musk, ambergris, santal, clary sage, benzyl isoeugenol, vanillin, coumarin, and Peru balsam.

(*b*) *Disagreeable*, such as asafetida, valerian, civet, skatole, castor, and indole.

(*c*) *Neutral*, such as benzyl benzoate, ethyl phthalate, and glyceryl acetate.

All these bodies may be further classified as to their source, *viz.* animal, vegetable, and synthetic.

The addition of odoriferous fixators to basic perfume materials will modify them slightly, which in the manufacture of fancy bouquets is not of much consequence, since the blend will often acquire a new note that is inimitable. On the other hand, it is not so easy to compound a natural flower perfume where the accurate reproduction of the odour is imperative. This is a delicate and difficult, though not impossible, operation, and is facilitated by the use of those fixators which bear a close resemblance to the flower odour being imitated. These cases are aptly illustrated by the employment of orris oleo-resin in violet, benzyl iso-eugenol or vanillin in carnation and clove pink, vanillin with traces of anisic aldehyde in heliotrope, hydroxy-citronellal and cinnamic alcohol in muguet and lilac, indole in jasmin, and patchouli in white rose. In blending the above-mentioned perfumes it is advisable to add small quantities of the fixator at first and gradually increase the proportion until the desired balance in odour is obtained. This must, however, be done in separate stages, otherwise the final blend of the perfume will not be all that is desired.

The process may be conveniently divided into three steps :—

(*a*) *Pre-fixation*, or complete de-odorisation of the solvent.

(*b*) *Blending*, or the addition of modifying fixators during manufacture.

(*c*) *Final fixation*, or the admixture of such additional substances as will produce the desired tenacity and distinctiveness, without changing the basic odour.

Pre-fixation, or the de-odorisation of alcohol, is a matter of much importance, and this preliminary operation is now carried out scientifically and with considerable ease. At one time, owing to the imperfect methods of alcoholic rectification, it was customary to add to the spirit tonka-beans, orris or vetivert roots, vanilla pods, etc. These were allowed to macerate for months, and sometimes for years, when the alcohol lost any objectionable smell it possessed and became slightly fragrant. With the present excise duty such lengthy operations would never pay, and as a result other processes have been devised. The best method is to add an aromatic resin extract whose odour is similar to the perfume for which the alcohol is to be used. One gram of resin extract added to 1 litre of alcohol will neutralise its characteristic aroma in a few weeks without giving it any specific odour, and in consequence the solution so obtained may be used for almost any perfume without much risk of spoiling the fragrance of the particular floral extract to be dissolved in it. A good example of such a resin for general use is benzoin R., but it must be remembered that the spirit containing it will, after volatilisation, leave a very thin film, having an almost imperceptible odour that will be at once lasting and satisfying to the user. It will be readily observed that this method possesses distinct advantages over the old one in that complete and identical results are obtained every time; further, it will be noticed that definite basic blends can be repeated by the addition of known percentages of fixators. As an illustration of this point, the addition of 1 gram of each of benzoin and tolu and ½ gram of olibanum to 1 litre of alcohol will give, in about one month, a perfectly de-odorised alcohol suitable for making verbena perfumes or some eau-de-Colognes. Similarly, the addition of certain quantities of labdanum, orris, and Peru balsam will produce a spirit well adapted for the oriental type of bouquet. Ginger and opoponax added to the latter will make it heavier and warmer, while oakmoss and vetivert will alter the aroma slightly, so that the alcohol can be used satisfactorily for trêfle, foin coupé, and fougère.

Blending will, of course, depend upon the particular perfume which is in course of preparation, and, according to whether it is of floral or of fancy type, so will the range of bodies that may be used suggest themselves. For example, in *violet* perfumes, santal, costus, ylang-ylang, and orris may be used; in *lily of the valley* creations, bois de rose, ylang-ylang, and hydroxy-citronellal can be employed; in *carnation*, heliotropin, iso-eugenol, and benzyl iso-eugenol are useful, while for *fancy bouquets* almost any of the fixators can be introduced, providing their notes combine to form a perfect harmony. It is safe to say that for a large number of floral perfumes, the better-known bodies, such as coumarin, vanillin, and heliotropin, can nearly always be utilised, but it is pointed out that traces of such articles as methyl naphthyl ketone and dimethyl hydroquinone will materially improve the fragrance of the finished product and are in consequence more suited for "perfumes de luxe." The odorous resins of ambrette, angelica, patchouli, santal, and vetivert should not be overlooked, as they are excellent substitutes for their corresponding essential oils.

Final Fixation is probably the most delicate operation in preparing a good and distinctive perfume, as it is this part of the process which gives distinction and "life" to the finished product. This step really consists of three operations:—

(*a*) The addition of some animal perfume, such as small quantities of musk, civet, ambergris, or castor, which will impart "warmth and life" and at the same time improve the aroma by softening down the harshness caused by the presence of synthetics.

(*b*) The addition of a small quantity of a substance, such as verbena, bergamot, or bois de rose, which will produce a sweet and pleasant effect.

(*c*) The addition of a suitable quantity of natural absolute, having fresh and glowing characteristics, such as jasmin, rose, mimosa, or tuberose, which will give the predominating flowery note to a perfectly harmonious mixture.

The finished perfume should be neither too animal nor too chemical if these points have had careful consideration.

There is no definite rule that can be laid down for the choice of fixatives other than the general principle of complete harmony between the various constituents employed in any one perfume. Every perfumery chemist has his own methods and frequently a comprehensive knowledge, acquired by practice, of a certain number of bodies which he is inclined to use as a base when building up all new creations. With a view to extending this list of fixatives, suggestions will be made later regarding the employment of some of the newer and more powerful bodies which it is hoped will be tried with good results. Before referring to these it will perhaps be advisable to illustrate the general outline given above by an example of an exceptionally persistent fancy bouquet of well-known type.

1. Take 1 litre of 90 per cent alcohol and add to it 5 grams of benzoin R., 2 grams orris oleo-resin, and 1 gram incense R. Allow the whole to mature for one month.

2. At the end of this period dissolve in the mixture 80 grams of ambrone, No. 1007, 3 grams undecalactone, 10 per cent, 1 gram of coumarin, 5 grams of musk ketone, and 1 gram of heliotropin. Stand aside for twenty-four hours after solution has been effected. The aroma of this compound will begin to assume "body" and some sweetness, but will not yet possess any distinctive characteristics. To improve the blend add 40 grams methyl ionone and 30 grams carnation, No. 1021.

3. To finally fix add (*a*) 6 grams strong tincture of musk, to give warmth and to soften; (*b*) 10 grams bergamot, to produce a sweet and pleasant effect; (*c*) 8 grams jasmin absolute, 3 grams neroli oil, 1 gram each absolutes of rose, tuberose, and orange blossom, to obtain a flowery odour. If the perfume has not enough floweriness, add a further 8 grams wallflower, No. 1110, 4 grams neroli, No. 1081, and 5 grams each jasmin, No. 1053, orange blossom, No. 1082. The formula now reads :—

Bouquet, No. 1001.

1000	Alcohol, 90 per cent.
5	Benzoin R.
2	Orris oleo-resin.
1	Incense R.
80	Ambrone, No. 1007.
3	Gamma undecalactone, 10 per cent.
1	Coumarin.
5	Musk ketone.
1	Heliotropin.
40	Methyl ionone.
30	Carnation, No. 1021.
6	Musk extract, 3 per cent.
10	Bergamot oil.
8	Jasmin absolute.
3	Neroli oil, finest.
1	Rose absolute.
1	Tuberose absolute.
1	Orange blossom absolute.
8	Wallflower, No. 1110.
4	Neroli, No. 1081.
5	Jasmin, No. 1053.
5	Orange blossom, No. 1082.
1220	

This makes an excellent perfume, the bouquet of which will be readily recognised.

NATURAL FIXATIVES.

Animal Fixators have been used by perfumers since antiquity, and to-day they may be said to constitute one of our most indispensable assets. Formerly they were added to mixtures of essential oils, flower pomades, and gum-resins, with a view to attenuating the odour and at the same time to give the perfume "life." Nowadays their employment is almost identical, excepting perhaps that the *form* in which they are used is more convenient. The discovery of artificial bodies of high melting and boiling-points has probably diminished their use to some extent, but it can never be argued that they have in any way *replaced* the animal fixators completely. Notable examples of these valuable synthetics are to be found in musk xylol, ketone and ambrette, exaltone and exaltolide, indole and skatole, and artificial ambers, but even when artistically employed along with gum-resins, essential oils, etc., they never give, with the possible exception of exaltolide, the "life" to a perfume that is attendant upon the use of animal fixatives. They do, however, make it possible to reduce the proportion of the latter class of bodies in any fragrant mixture, and at the same time tend to diminish the fugitive nature of the aroma. The most important bodies of animal origin are—ambergris, musk, civet, and castor. Their odours are of a type, yet they all possess distinct and different notes. Broadly, ambergris may be said to be earthy, musk pleasantly aromatic, civet disagreeable, and castor tarry. This, of course, applies to the raw material, and it is only in extreme dilution and after long maturing that a resemblance is apparent. In fancy bouquets and some flower bouquets a mixture of two or more of these bodies will give the best effects, while in other cases, one of them will blend with the predominating note of a perfume better than another. As an instance of this, civet is superior to castor for muguet flower perfumes, while ambergris is the best for old-fashioned eau-de-Colognes. On the other hand, a mixture of musk and civet in large proportions is most appreciated in perfumes of the oriental type. Formerly it was the custom to use these animal fixatives in the form of a tincture which in many cases was matured for years. Nowadays these methods are still used by many perfumers, but the application of percolation (in the case of musk) has made it possible to extract all the odoriferous principles in a much shorter time, and in consequence the extract requires less maturing. In the case of ambergris there is no known factor which may be substituted for lengthy maturing, details of which are given in Volume I. The extraction of civet and castoreum by the volatile solvent process has made the use of absolutes of these two substances possible with success.

They may be employed in compounds, advantage of which is taken in such examples as chypre and fougère. In the preparation of musk extract the addition of a weak alkali is sometimes advisable, as it helps to bring out the odour, and the carbonates of potash and ammonium are much used for this purpose. The following formula may be taken as a general indication of the proportions to use :—

No. 1002.

30	Crude animal product.
1	Alkali.
1000	Alcohol of suitable strength.
1031	

Note.—The lixiviation of the raw material is considerably facilitated by the employment of an equal weight of powdered orris-root or sand.

Vegetable Fixators have been in use since the dim ages of the pre-Christian era, as is shown by the references of ancient writers to such substances as myrrh, frankincense, and spikenard. Nowadays they constitute some of our most useful raw materials, as when mixed with other volatile substances, they possess the remarkable property of equalising their various rates of evaporation. The most important groups of these bodies are essential oils and balsams, gums or oleo-resins.

The majority of **Essential Oils** do not possess tenacious odours, but there are a few whose physical characteristics enable them to be classed as fixators. Among the more important members of this group are angelica, clary sage, orris, patchouli, santal, and vetivert. These oils have a very high boiling-point, and, in consequence, a slow rate of evaporation. When mixed with other more volatile bodies they prevent rapid evanescence, and produce a mixture having a tenacious odour—hence their inclusion in this class. It is not often that they are used for this purpose alone, as in the majority of cases they act rather as blenders than as fixators. This is well illustrated in the case of patchouli, for when this oil is added in traces to a synthetic rose base, it alters the odour very slightly, and the mixture recalls a bouquet of white roses rather than of red roses, and at the same time the otto retains its odour for a much longer period when used. Any of the above-mentioned oils make excellent fixers for fancy perfumes ; for those of the sweet flowery type aubrette and clary sage are excellent, for the violet type orris and santal are indispensable, while for the oriental bouquet it is difficult to find a more suitable *base* than either patchouli or vetivert. It is quite a common practice in the latter class of perfumes to make the mixture up entirely of fixatives, the bodies suitable for this purpose being well illustrated in the introductory remarks to this chapter.

The essential oil which is pre-eminent as a fixator for *any* perfume is unquestionably *clary sage*. The majority of floral compounds are made with synthetic aromatic chemicals, and they rarely compare favourably with the natural flower extract on account of their harshness. Those of finest quality are usually the result of the artistic union of synthetics with nature, in that as much as 10 per cent of the flower absolute is added during manufacture. The odour of the resulting product after one month is smoother and approximates more nearly to the natural flower, but the addition of $\frac{1}{10}$ to $\frac{1}{2}$ per cent of clary sage oil will in *less than one month* give results which are unobtainable with any other material. The "chemical smell" during the first two or three days will become harsher, coarser, and less like the odour it is intended to imitate, but a peculiar sweetness and flower freshness will develop after one week until at the end of a month the synthetic will have lost its raw odour, and will have assumed a characteristic fragrance and a remarkable tenacity. As an example of these exceptional properties, the following formula for *trèfle de luxe* should be tried :—

Trèfle, No. 1003.

200	Amyl salicylate.
200	Iso-butyl salicylate.
50	Benzyl salicylate.
100	Bergamot oil.
50	Ylang oil—Manila.
10	Oakmoss absolute, green.
50	Lavender oil.
20	Patchouli oil.
30	Vetivert oil—Java.
40	Hawthorn, No. 1037.
30	Rose, No. 1090.
25	Jasmin, No. 1053.
25	Clary sage, concrete.
20	Neroli, No. 1081.
20	Vanillin.
10	Phenylacetic acid.
30	Musk ketone.
30	Heliotropin.
60	Coumarin.

Clary sage oil is also invaluable as a blender and fixer in alcoholic perfumes, and particularly in toilet waters—*see* Eau-de-Cologne.

Balsams, Gums, and **Oleo-resins.**—Many of these substances are employed as fixatives in different types of perfumes, and some slight reference to their constitution seems desirable here.

The average commercial sample consists of the natural plant exudation together with extraneous matter, which is of course removed as demonstrated below, but occurs with the substance, often owing to the very crude methods used during collection in its native country. The valuable portion of the material contains two different bodies—

1. A small quantity of essential oil of characteristic odour, which can be separated by the usual methods if desired.

2. A large proportion of soluble resin, miscible with the various basic perfume materials, and constituting the real fixator.

In order to obtain the active ingredients of this class of bodies in a form which can be easily handled and used with mathematical accuracy, one general and simple method is applied which is really more or less common in the drug trade. It consists of exhausting the crude material with ethyl alcohol, iso-propyl alcohol, petroleum ether, acetone, or other volatile solvent by means of maceration or percolation, and subsequent removal of the solvent by distillation at a low temperature, *in vacuo*. These bodies do not thereby lose any of their odoriferous constituents, but they represent all that is of value to the perfumer, and in a very convenient form. They are known as *resinodors*, *gomodors*, *clairs*, *R.*, etc., and are represented by benzoin, cistus, olibanum, styrax, oakmoss, orris, Peru, copaiba, etc. These bodies are the most perfect fixators, and exact quantities can be used always, which is a distinct advantage in the preparation of any perfume. It should be noted that when preparing them the strength of solvent used should correspond with the strength of alcohol, for example, in the finished perfume; otherwise some of the constituents will be thrown out of solution, and filtration will become necessary. The quantity of "R." to be used in any perfume will vary according to the odour and the persistence desired; for general use up to 1 per cent of *benzoin* is recommended for alcoholic perfumes. The aroma of this particular raw material is pleasant without being too characteristic, and it will blend so well that its odour will never be noticeable. On the contrary, styrax will blend better with hyacinth perfumes, olibanum with champaca, cistus with verbena, oakmoss with trèfle, orris with violet, Peru with any perfume where warmth is desired, etc.

The proportion of "R." which is added to a *non-alcoholic* perfume is frequently high, and in the case of benzoin is sometimes as much as 30 per cent of the finished product. This is accounted for to some extent by its smooth and sweet odour, but those bodies, such as olibanum, labdanum, etc., whose odours are stronger will not exceed 5 to 10 per cent, and they are frequently used as weak as 1 per cent, if other fixators are present in the compound.

ARTIFICIAL FIXATIVES.

The very wide range of **Synthetic Aromatic Chemicals** from which many valuable fixatives can be chosen is due to much patient research on the part of chemists. Up to a few years ago the only synthetics which were well known and largely employed were coumarin, vanillin, heliotropin, and musk Baur, and as every perfumery chemist is familiar with their properties and uses, it will not be necessary to give any details here. It seems desirable, however, that some reference should be made to other important fixative bodies, as every worker is on the look-out for new synthetics which will enable him to create new perfumes of perfect tenacity. Among the acids a very important and cheap article is *phenylacetic acid*. It occurs naturally in several flowers or flower extracts—for example, orange flower and the rose. Its odour recalls honey and civet, and when used in small quantities it produces a pleasant and cooling persistence. It should not be used in large quantities, otherwise a very objectionable effect will be produced in the same way as an excess of castor. Another cheap synthetic of weak odour is *benzoic acid*. It will blend well with any perfume, and its odour will not be noticeable. A better fixative than this is *cinnamic acid*, which occurs in benzoin and tolu, and from which raw materials it may be extracted. The *alcohol* and *esters* are, however, much more persistent, and in consequence more popular, especially in the preparation of amber Colognes and lavender waters. Among the esters, ketones, etc., we have a large choice; a comparatively cheap article of amber odour is *amyl benzoate*. This can be used in all types of artificial ambers, and is a good base for ottos of oriental type. *Benzophenone* is a valuable crystalline fixative of pleasant odour that can be used in almost any sweet floral bouquet. *Benzylidene acetone* is a solid with a delightful flower odour, and even in traces is remarkably persistent. *Benzyl iso-eugenol* has a great future.

It is expensive, but nothing can replace it as a fixer for carnation or clove pink, while traces in synthetic rose are invaluable. *Diphenyl methane* and *diphenyl oxide* have a sweet geranium odour and can well be used in perfumes of that type. *Dimethyl hydroquinone* has an odour of melilot, and with coumarin and musk ambrette will fix foin coupé perfumes. *Methyl naphthyl ketone* should be tried in the orange blossom type of floral otto, and it will then need no further recommendation. *Hydroxy-citronellal* owing to its high boiling-point is difficult of evaporation. It has a lily odour and can be employed in all sweet flowery perfumes. *Iso-butyl benzoate* is of the neroli type, and it will be found useful as a fixative in synthetic orange flower bouquets. *Skatole*, like *indole*, is objectionable in a concentrated form, but in dilution will be found useful in place of civet. *Styrone* is a valuable fixer for the hyacinth type of perfume. *Beta naphthol butyl ether* is a useful crystalline fixative for Colognes, but should be employed in small quantities only. Many of the *aldehydes* are very persistent, such as cyclamen, phenylacetic, decyl, undecyl and methyl nonylacetic. Traces only will remain right up to the end of evaporation. This list is capable of much extension, but a complete classification of fixatives will be found towards the end of this chapter. The quantity of any synthetic fixer or blender will require to be carefully added in order to prevent any suggestion of a chemical smell. A good plan is to use an equal weight of balsam or gum-resin to obtain more perfect balance. In order to avoid the possibility of spoiling a perfume by the injudicious addition of synthetic fixatives, many manufacturers keep a series of perhaps half a dozen **Compounds**, consisting of animal, vegetable, and synthetic fixators, suitably blended, and each having a distinct floral note produced by the addition of a small quantity of flower extract. A most important branch of this series is to be found in the so-called *synthetic ambers*. They are all of a musky tendency and are particularly useful for any type of fancy bouquet; up to 1 per cent may be used in any alcoholic handkerchief perfume, while as much as

20 per cent can be added to a concentrated flower compound.

The following formulæ for **Liquid Ambers** may be endlessly modified to suit individual tastes :—

No. 1004.

500	Musk extract natural, 3 per cent.
175	Civet " " "
100	Castor " " "
50	Musk ambrette.
25	Clary sage oil.
25	Rose otto virgin.
25	Cistus R.
100	Benzoin R.
1000	

No. 1005.

400	Civet extract natural, 3 per cent.
200	Musk " " "
50	Musk ketone, 3 per cent.
25	Phenylacetic acid.
50	Vanillin.
25	Jasmin absolute.
25	Dimethyl hydroquinone.
100	Balsam Peru.
25	Ambrette oil.
100	Amyl benzoate.
1000	

No. 1006.

300	Musk extract natural, 3 per cent.
200	Castor " "
50	Clary sage oil.
100	Coumarin.
100	Benzyl iso-eugenol.
25	Oakmoss resin.
100	Tolu R.
25	Jasmin absolute.
100	Ethyl phthalate.
1000	

Ambrone, No. 1007.

120	Mandarin oil.
110	Bergamot oil.
100	Labdanum R.
100	Benzoin R.
80	Iso-butyl benzoate.
70	Civet extract, 3 per cent.
65	Jasmin, No. 1053.
35	Rose, No. 1090.
30	Patchouli oil—Singapore.
30	Castor extract, 3 per cent.
25	Cypress oil.
10	Vetivert oil—Bourbon.
25	Ethyl protocatechuic aldehyde.
40	Musk ketone.
70	Çoumarin.
90	Heliotropin
1000	

The next series of formulæ will indicate the lines on which special **Floral Fixators** may be compounded. They possess a fresher and more characteristic odour than the *ambers*, and the flower perfume can be built up from them quite easily :—

Roseophyx, No. 1008.

225	Cinnamic alcohol.
25	Patchouli oil—English.
25	Vetivert oil—English.
25	Geranyl acetate.
50	Liquid amber R.
50	Bulgarian rose otto.
100	Benzyl iso-eugenol.
100	Benzoin R.
400	Rhodinyl phenylacetate.
1000	

Œilletophyx, No. 1009.

300	Benzyl iso-eugenol
50	Musk ambrette.
100	Heliotropin.
50	Incense R.
100	Vanillin.
100	Amyl salicylate.
300	Benzoin R.
1000	

Violettophyx, No. 1010.

100	Orris oleo-resin.
30	Ambrette oil.
50	Orris oil concrete.
20	Ethyl myristinate.
150	Coumarin.
50	Vanillin.
100	Musk ambrette.
150	Benzyl iso-eugenol.
50	Violet leaves absolute.
100	Tolu R.
50	Labdanum R.
150	Benzoin R.
1000	

Jasmaphyx, No. 1011.

50	Indole.
50	Benzyl formate.
200	Tolu R.
100	Peru R.
50	Methyl anthranilate.
50	Jasmin absolute, chassis.
200	Benzoin R.
100	Hydroxy-citronellal.
200	Benzyl propionate.
1000	

The following two formulæ will make suitable **Oriental Fixators**:—

Luxorania, No. 1012.

200	Myrrh R.
50	Olibanum R.
100	Cistus R.
200	Balsam, Peru.
50	Tolu R.
50	Ethyl cinnamate.
30	Patchouli oil.
20	Vetivert oil.
50	Coumarin.
50	Musk ambrette.
100	Civet extract natural, 3 per cent.
100	Musk " " "
1000	

Luxoranthia, No. 1013.

50	Patchouli oil—English.
50	Male fern R.
150	Geranium R.
50	Benzyl cinnamate.
150	Heliotropin.
100	Musk ketone.
400	Ambrone, No. 1007.
30	Benzophenone.
20	Anisic aldehyde.
1000	

The two compounds indicated below are useful as **Toilet Water Fixators**:—

Lavendex, No. 1014.

50	Vanillin.
100	Borneol.
50	Musk ambrette.
200	Musk natural extract, 3 per cent.
25	Vetivert oil—Java.
25	Nutmeg oil.
50	Lavender oil—English.
500	Bois de rose oil.
1000	

Colognez, No. 1015.

100	Benzyl iso-eugenol.
50	Ethyl cinnamate.
50	Methyl naphthyl ketone.
100	Cinnamic alcohol.
50	Clary sage oil.
150	Petitgrain oil, terpeneless—French.
500	Iso-butyl benzoate.
1000	

It should be remembered that any compound fixatro must be as near perfection as possible, owing to the preference the present-day public have for a perfume that will "hold," and in many cases it is necessary for *half* the compound to consist of fixator. In compounding alcoholic perfumes it is advisable to mix the compound fixator with the absolute essences and allow the mixture to blend a few days before adding the spirit. A good process for the manufacture of persistent odoriferous fancy floral ottos is to build them up with the fixator as the base. One takes, for example, one part of roseophyx, No. 1008, to which one adds two parts of jasmin, No. 1053, when a very persistent perfume results. By the further addition of one part of ambrone, No. 1007, and two parts of muguet, No. 1063, or tuberose, No. 1101, one obtains a delightful flower bouquet of great tenacity.

CLASSIFICATION OF FIXATORS.

1. *Essential Oils.*

Basil.	Nutmeg.[1]
Bois de rose.	Origanum.
Cananga.	Patchouli.
Cassia.	Peru.
Cedarwood.	Saffron.
Clove.	Salvia sclarea.
Coriander.	Santal.
Costus.	Sassafras.
Cumin.	Spikenard.
Cypress.	Sumbul.
Guaiac-wood.	Tarragon.
Iris.	Thuja.
Linaloe.	Thyme.
Mace.	Valerian.
Marjoram.	Vetivert.
Myrtle.	Ylang-ylang.

2. *Balsams, Gums, Oleo-Resins, etc.*

Ambrette.	Male fern.
Ammoniacum.	Mastic.
Angelica.	Moss—Corsican
Asafœtida.	Myrrh.
Benzoin.	Oakmoss.
Camomile.	Olibanum.
Cascarilla.	Opoponax.
Cistus.	Patchouli.
Clove.	Peru.
Copaiba.	Sandarac.
Elemi.	Santal.
Galbanum.	Sumbul.
Geranium.	Storax.
Ginger.	Tolu.
Iris.	Tonka beans.
Juniper.	Vanilla.
Labdanum.	Vetivert.

3. *Synthetic Aromatic Chemicals with Boiling-points C.*

Acetyl iso-eugenol, 282°.
Amyl benzoate, 261°.
,, phenylacetate, 268°.
,, salicylate, 279°.
Benzophenone, 307°.
Benzyl butyrate, 242°.
,, cinnamate, 200°.
formate, 202°.
iso-eugenol.
phenylacetate, 318°.
propionate, 228°.
valerianate, 250°.
Benzylidene acetone, 260°.
Butyl phthalate, 312°.
Cinnamic acid, 300°.
,, alcohol, 258°.
,, aldehyde, 253°.
Cinnamyl acetate, 262°.
,, cinnamate.
Coumarin, 300°.
p-Cresyl acetate, 213°.
Cuminic aldehyde, 235°.
Dimethyl benzyl carbinol, 225°.
,, hydroquinone, 212°.
Diphenyl methane, 263°.
,, oxide, 258°.
Ethyl anthranilate, 260°.
Ethyl cinnamate, 271°.
,, phenylacetate, 227°.
,, salicylate, 234°.
,, succinate, 216°.
Heliotropin, 263°.
Hydroxy-citronellal.
Indole, 255°.
Iso-butyl benzoate, 237°.
,, phenylacetate, 254°.
,, salicylate, 260°.
Methyl acetophenone, 220°.
cinnamate, 261°.
eugenol, 248°.
iso-eugenol, 263°.
naphthyl ketone, 295°.
phenylacetate, 260°.
salicylate, 224°.
Musks—artificial.
Naphthyl butyl ether.
,, ethyl ether, 282°.
,, methyl ether, 274°.
Phenylacetic acid, 266°.
Phenylethyl butyrate, 260°.
Phenylpropyl alcohol, 235°.
Santalol, 302°.
Skatole, 265°.
Vanillin, 285°.

4. *Nearly Odourless Synthetics with Boiling-points C.*

Amyl phthalate, 336°.
Benzoic acid, 249°.
Benzyl benzoate, 323°.
Cyclohexanol oxalate, 220°.
Diethyl glycol, 245°.
Ethyl benzoate, 212°.
Ethyl phthalate, 293°.
Resorcinol diacetate, 278°.
Tricresyl phosphate, 430°.
Triethylene glycol, 276°.
Triphenyl phosphate, 410°.

FLOWER PERFUME FIXATORS—CLASSIFIED.

The following tabulation is intended to assist those who are desirous of obtaining the best fixatives for flower perfumes :—

Acacia.—Myrrh, Peru, tolu, musks, civet vanillin, hydroxy-citronellal.

Broom.—Musks, olibanum, sumbul, vetivert.

Carnation.—Œilletophyx, benzyl iso-eugenol, ambrette, benzoin, labdanum, musks, clary sage, cinnamic alcohol.

Cassie.—Violettophyx, orris oleo-resin, styrax, costus, coumarin, vanillin, tolu, methyl naphthyl ketone.

Champaca.—Benzyl iso-eugenol, ambrette, olibanum, tolu, vanilla, musk natural, cinnamyl cinnamate.

Cologne.—Colognez, clary sage, benzyl iso-eugenol, ethyl cinnamate, β-naphthol ethers, benzoin, ambergris, musk natural.

Corylopsis.—Roseophyx, civet, oleo-resin orris, violettophyx, ambrette, vanillin.

Fern.—Oakmoss resin, vanillin, benzyl iso-eugenol, coumarin, dimethyl hydroquinone, male fern.

Hawthorn.—Benzoin, costus, styrax, vetivert, hydroxy-citronellal.

Heather.—Elemi, olibanum, benzoin.

Heliotrope.—Cinnamic alcohol, benzoin, Peru balsam, tolu.

Honeysuckle.—Mastic, tolu, olibanum, vanillin, hydroxy-citronellal.

Hyacinth.—Storax, benzoin, cistus, costus, cinnamic alcohol, musks.

Jasmin.—Indol, jasmaphyx, Peru, tolu, styrone, costus, hydroxy-citronellal, civet.

Jonquille.—Benzoin, vanillin, basil, patchouli.

Lavender.—Mastic, musk, amber liquid, styrax, lavendex.

Lilac.—Hydroxy-citronellal, vanillin, tolu, ambergris, Peru balsam, benzoin.

Lime or Linden.—Hydroxy-citronellal, benzoin, musk ketone, mastic, tolu, ambrette.

Magnolia.—Balsam Peru, benzylidene acetone, amber liquid, styrax, civet, musk natural, mastic, benzyl iso-eugenol.

Mimosa.—Cinnamic alcohol, Peru, mastic, tolu, musks, violettophyx.

Muguet.—Hydroxy-citronellal, benzoin, civet.

Narcissus.—*p*-Cresyl phenylacetate, benzoin, labdanum, costus, musks.

New Mown Hay.—Coumarin, oakmoss, thuja, dimethyl hydroquinone, clary sage, diphenyl methane, diphenyl oxide.

Night Scented Stock.—Cinnamic alcohol, benzoin, Peru balsam, tolu, styrax, benzyl iso-eugenol, clary sage.

Orange Flowers.—Musks, benzoin, mastic, olibanum, tolu, Peru, indol, iso-butyl benzoate, methyl naphthyl ketone.

Orchids.—Oakmoss, benzoin, Peru, musk, vanillin, ylang-ylang, coumarin, phenyl-acetic acid.

Reseda. — Violettophyx, orris, labdanum, costus, styrax, basil.

Rose.—Roseophyx, vetivert, patchouli, styrax, santal, hydroxy-citronellal.

Sweet-Pea.—Benzylidene acetone, iso-butyl phenylacetate, tolu, Peru, hydroxy-citronellal, mastic, cinnamic alcohol, musks.

Sweetbrier.—Benzoin, civet, styrax.

Trèfle.—Clary sage, benzyl iso-eugenol, oakmoss, benzoin, Peru, dimethyl hydroquinone.

Tuberose.—Peru balsam, iso-butyl benzoate.

Verbena.—Cistus, elemi, copaiba, benzoin, styrax, vanillin, olibanum, orris oleo-resin.

Violet.—Violettophyx, oleo-resin orris, ambrette, vanillin, benzyl iso-eugenol, costus.

Wallflower.—Benzoin, benzyl iso-eugenol, cistus, musks.

CHAPTER VI.

MONOGRAPHS ON FLOWER PERFUMES.

ACACIA.

Acacia is the name of an extensive genus of trees and shrubs of the N.O. Leguminosæ, varying in habit from heath-like shrubs to lofty trees, and widely spread throughout the tropical and sub-tropical regions of both hemispheres. The inflorescences take the form of compact globose heads or spikes of various colours, generally white, pink, or yellow, the latter being the predominant colour in the Australian species.

Varieties.—In India the genus is represented by about eighteen species of trees of various sizes, distributed throughout the country, some attaining a height of 100 ft., especially in the forests of Pegu and Prome. In Western Asia and Africa the genus is represented by gum-yielding species, such as *A. Arabica* and *A. Senegal*, which are small-sized, thorny trees of forbidding aspect and frequently occupying large tracts of desert country. Other species of acacia are also common in the West Indies and tropical America, where they are valued for their timber. In Australia this genus is profuse, and as many as 300 different species are recorded, several of which are of great commercial value as the bark is used for tanning. Among the more important of these are *Acacia decurrens*, known as the black wattle in Victoria and Tasmania; *A. dealbata*,[1] the silver wattle; and

[1] *See also* Mimosa.

A. pycnantha, the broad-leaf wattle. In Southern Europe and Western Syria the genus is represented by *A. Julibrissin* and *A. Farnesiana*.[1] In this country, the South of France and Northern America, the trees generally but erroneously referred to as acacia are *Robinia pseudacacia*, having aromatic white flowers, which appear during May and June and impart a pleasant odour to the avenues and gardens they adorn. Originally a North American species, the tree was introduced into Britain some 250 years ago and is to-day much admired. It attains a height of 40 or 50 feet and averages $2\frac{1}{2}$ feet in diameter.

Odour.—Several acacias possess sweet-scented flowers, and of these (with the exception of *A. Farnesiana* and *A. dealbata*, which will be dealt with in separate monographs) the more important are *A. biflora* and *A. hastulata*. The odour of the former recalls the coco-nut, while that of the latter resembles hawthorn, but as far as is known neither have been turned to practical account for the extraction of their perfume in Europe. In Australia, however, there is a perfume known as "wattle blossom," obtained from the flowers, collected after sundown. It is prepared by macerating them in olive oil, which when saturated is extracted with strong alcohol. The odour of the flowers of *Robinia* approximates more nearly to that of the *A. hastulata* and will therefore be taken as the standard flower for its synthetic prototype.

Chemistry.—The flowers of *Robinia pseudacacia* have been subjected to an examination by F. Elze,[2] who extracted the blossoms with a readily volatile solvent and obtained a very dark-coloured oil with a peculiar basic odour which, when diluted, reproduced the natural flower fragrance. This oil contained 9 per cent of ester calculated as methyl anthranilate. In alcoholic solution it gave a clearly perceptible

[1] *See also* Cassie.
[2] "Report" of Schimmel & Co. (Oct. 1910), 107.

blue fluorescence, and on dilution with ethereal sulphuric acid yielded this substance. The following further constituents were also identified: indole, heliotropin, benzyl alcohol, linalol, and α-terpineol. In addition, aldehydes and ketones with a decided odour of peach, and probably also nerol are present.

Compounding Notes.—In commerce artificial acacia perfumes, as distinct from cassie and mimosa, have an intensely sweet may blossom note and are therefore largely based upon anisic aldehyde in combination with para-methyl acetophenone. This base is enhanced by the addition of traces of methyl naphthyl ketone and phenylacetic acid. These are blended with bois de rose oil, phenyl-acetic aldehyde, benzyl acetate bergamot, and one or other of the rose alcohols, supplemented by the addition of jasmin, rose, and neroli, the mixture being fixed with musk or any of the other bodies mentioned in the classified list. Modifiers which at the same time impart a deeper tone to the compound may be chosen from heliotropin, dimethyl hydroquinone, coumarin, acetanisol, vanillin or ketone musk. Special floral notes are obtainable by the addition of traces of pseudo-aldehydes C_{14} and C_{16} in 10 per cent solution.

Synthetic Components:—

Bases.—Anisic aldehyde, *p*-methyl acetophenone, phenyl-acetic acid, methyl anthranilate, diphenyl oxide.

Blenders.—Bois de rose, bergamot, linalol, rhodinol, citronellol, phenylacetic aldehyde, benzyl acetate, terpineol, benzyl alcohol.

Modifiers.—Cinnamic alcohol, α-ionone, heliotropin, coumarin, ylang, hydroxy-citronellal, phenylethyl alcohol, iso-butyl benzoate and phenylacetate, acetanisol.

Fixers.—Musk, civet, ketone musk, vanillin, tolu and Peru balsam, vetivert, benzoin R., methyl naphthyl ketone.

Florales.—Rose, jasmin, neroli, orange blossom.

Aldehydes.—C_9, C_{14}, C_{16}.

The formulæ given below will illustrate these modifications :—

Acacia, No. 1016.

340	Anisic aldehyde.
50	Para-methyl acetophenone.
100	Bois de rose oil.
50	Phenylacetic aldehyde.
50	Citronellol.
50	Benzyl acetate.
45	Rose, No. 1090.
55	Jasmin, No. 1053.
50	Methyl anthranilate.
80	Iso-butyl benzoate.
20	Musk ketone.
10	Vanillin.
20	Coumarin.
70	Heliotropin.
10	Undecalactone, 10 per cent.
1000	

Acacia, No. 1017.

350	Anisic aldehyde.
30	Para-methyl acetophenone.
50	Cinnamic alcohol.
100	Petitgrain oil, terpeneless.
50	Iso-butyl phenylacetate.
20	Rhodinol.
30	Benzyl acetate
20	Linalol.
20	Hydroxy-citronellal.
50	Benzoin R.
50	Phenylethyl alcohol.
30	Phenylacetic aldehyde.
30	Neroli oil.
10	Rose otto.
10	Jasmin absolute.
30	Vanillin.
20	Phenylacetic acid.
10	Methyl naphthyl ketone.
80	Heliotropin.
10	Ethyl methyl phenyl glycidate, 10 per cent.
1000	

Handkerchief Perfumes can be made from either of the foregoing as follows :—

No. 1018.

100	Acacia, No. 1017.
30	Musk extract, 3 per cent.
870	Alcohol.
1000	

No. 1019.

75	Acacia, No. 1016.
20	Civet extract, 3 per cent.
5	Jasmin absolute.
10	Rose absolute.
10	Benzoin R.
880	Alcohol.
1000	

or compounded direct :—

No. 1020.

10	Jasmin absolute.
3	Orange blossom absolute.
4	Rose absolute.
1	Tuberose absolute.
1	Cassie absolute.
20	Civet extract, 3 per cent.
6	Lemon oil.
10	Bergamot oil.
5	Anisic aldehyde.
1	Phenylacetic aldehyde.
10	Vanilla extract, 10 per cent.
3	Neroli oil.
1	Methyl naphthyl ketone.
4	Heliotropin.
1	Gamma undecalactone, 1 per cent.
920	Alcohol.
1000	

CARNATION.

History.—The Greek philosopher Theophrastus, in his "Enquiry into Plants," VI., 6, 2, states that the gillyflower (? stock) is sweet-scented, but that the carnation and wallflower are *scentless*, from which it is evident that this flower was known in the fourth century B.C. There appears to be no clear record of the introduction of the carnation into Britain, some writers stating that it came from Germany, and others that it was imported from Italy and the shores of the Mediterranean. There is no doubt, however, that the spicy fragrance of the flower has been appreciated for centuries throughout Europe, and was very much favoured in the time of Queen Elizabeth. In later years the poet William Shenstone wrote of it as follows :—

> Let your admired carnation own,
> Not all for needful use alone;
> There while the seeds of future blossoms dwell,
> 'Tis coloured for the sight, perfumed to please the smell.

The clove pink, *Dianthus caryophyllus*, of which the carnation is a variety, is a grass-leaved herbaceous plant of the N.O. Caryophyllaceæ. The origin of the name "clove" is worthy of mention. It is derived from the French word *clou*, English "clout," a nail, from the imaginary resemblance of the clove flower to the head of a nail. Tournefort, a French botanist who died in 1708, is supposed to have given it the specific name *Caryophyllus* on account of its similarity to some of the short-leaved species of the genus *Carex* and its allies. The word *Caryophyllus* is also applied to the molucca clove, although there is no likeness between the two; nevertheless Tournefort's name of *Caryophyllus aromaticus* was adopted by early botanists for this well-known spice. This consists of the dried, unexpanded flower-buds of a tree of the N.O. Myrtaceæ, which is now known as *Eugenia caryophyllata.*

Varieties.—There are over fifty species of *Dianthus*, with numerous varieties, believed by some horticulturists to exceed 2000, and including carnations, pinks, picotees, and sweet-williams. Some of the well-defined species are :—

D. Chinensis—beautiful but inodorous.
D. Barbatus—the sweet-william.
D. Hortensis—the garden pink.
D. Plumarius—the pheasant's eye.
D. Deltoides and D. Caesius—both commonly occur wild.

Carnations are grouped by florists, according to the markings of the flower, as follows :—

Bizarres—spotted or striped with several shades (usually three).

Fancies—with markings on coloured grounds.

Flakes—of two colours, striped longitudinally.

Picotees—with tinted petal edges.

Selfs—of one colour.

On referring to the catalogues of any of the well-known horticulturists there will be found hundreds of these varieties of carnations, and, like roses, they are known by all sorts of fancy names. From the point of view of odour, however, white carnations are generally to be preferred to red ones. Along the French and Italian Rivieras very large tracts of land are devoted to the cultivation of these exquisite flowers. Visitors will have noticed them in particular near Nice and Antibes and also near Ventimiglia, Bordighera, and San Remo. The blossoms begin to appear as early as September and continue until July. The major portion of them are sold as cut flowers and sent to Paris and London. As an indication of the importance of this business, it is interesting to note that between 350 and 400 thousand kilos of carnations are sold annually by French growers and about 150 thousand kilos by Italians.

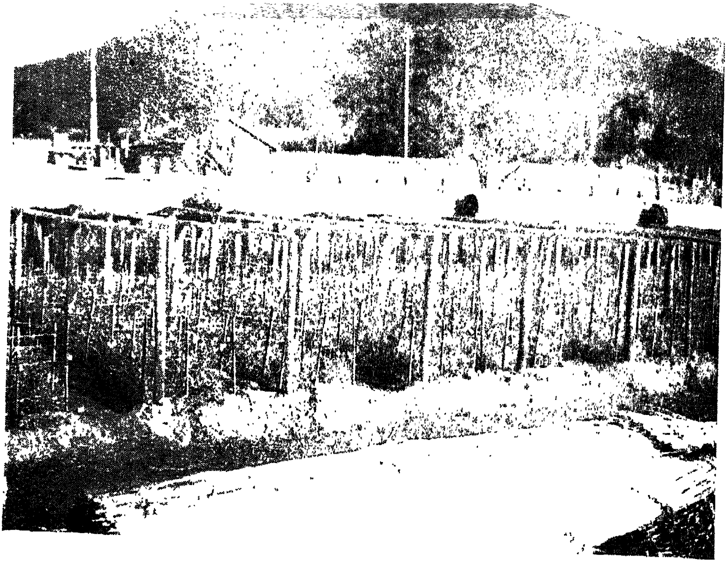
Odour.—The carnation has developed its rich, spicy odour with cultivation, although it is a peculiar fact that horticulture is responsible for many beautiful forms which are almost devoid of perfume. In the wild state it seldom possesses either of these qualities, and is occasionally found growing on dry soil.

Natural Perfume.—Although, as stated above, large quantities of carnations are grown in the south of France, by far the greater proportion are sold for decorative purposes. In certain parts of the Var near Grasse the flowers are grown especially for perfumery purposes. Those of

[Sutton & Sons.

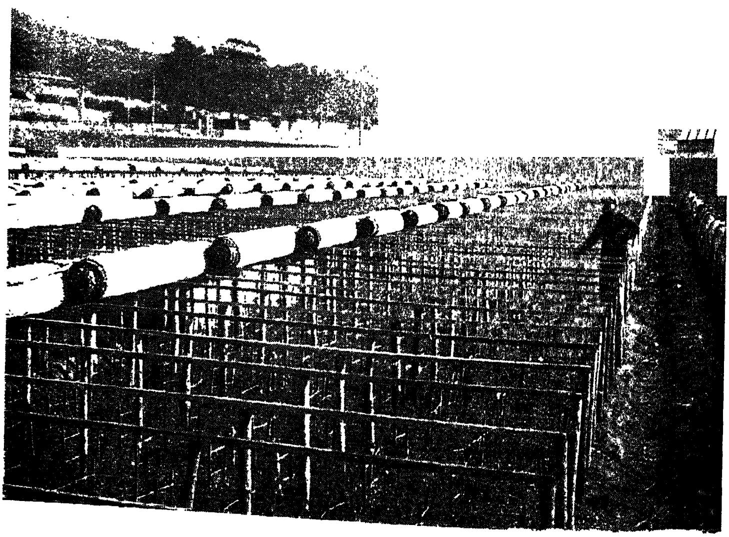
FIG. 28.—Carnations.

[To face page 96.



[*La Parfumerie Moderne.*

FIG. 29.—The cultivation of Carnations in flower at Carquieraine (Var.).



[*La Parfumerie Moderne.*

FIG. 30.—Carnations—ventilation of the same cultures in January, 1923.

importance are white, pink, pink and red, and yellow and red. The harvest takes place in June, and the blossoms are picked after exposure to about three hours of brilliant sunshine. The perfume is then at its maximum fragrance. It is extracted nowadays almost exclusively by means of volatile solvents. About 500 kilos of flowers yield 1 kilo of concrete. This has a rather high wax content and the yield of absolute is in the region of 10 per cent only. This has a waxy odour of heavy carnation type and is eminently suited for sophisticated perfumes. In Holland a quantity of carnations are grown for perfumery purposes and are extracted by volatile solvents by a well-known firm at Roermond.

Chemistry.—To distillation 1000 kilos of carnation flowers yield 30 grams (0·003 per cent) of a pale green solid having an intense odour resembling that of the nine and ten carbon atom aldehydes. On extreme dilution this develops the true flower odour.

The chemistry of carnation flower oil has not received much attention, probably owing to its meagre yield. Recently, however, it has been studied by Glichitch[1] who isolated from the distilled extract 31 per cent of stearophene which appeared to be identical with heptacosane. He removed traces of an aldehyde when the residual oil had an odour reminiscent of cinnamyl and citronellyl acetates. More recently Treff and Wittrisch[2] have experimented upon clove pink blossoms grown at Gröba, in Saxony. They extracted 2·840 kg. of flowers with petroleum ether and obtained a yield of 8·0 kg. = 0·289 per cent of solid extract. This was treated with alcohol to remove inodorous matter, yielding 2·5 kg. = 0·088 per cent of pure extract. This was finally steam distilled to yield 122·65 grams = 0·00432 per cent of volatile oil. Upon chemical examination the following substances were identified :—

[1] "Les Parfums de France" (1923), 10-11, 47.
[2] "Journ. f. prakt. Chem." (1929), 332.

Eugenol	30 per cent.
Phenylethyl alcohol	7 ,, ,,
Benzyl benzoate	40 ,, ,,
Benzyl salicylate	5 ,, ,,
Methyl ,,	1 ,, ,,

Previous experiments during 1926 in collaboration with Ritter gave the following yields :—

Solid extract	0·282 per cent.
Pure ,,	0·0926 ,, ,,
Volatile oil	0·00498 ,, ,,

On this occasion they surmised only the presence of eugenol.

Compounding Notes.—There are many carnation oils on the market, and most of them are compounded exclusively from synthetics. The basis of most artificial ottos is iso-eugenol, and this frequently represents 60 per cent of the total. This is backed up with eugenol, amyl salicylate, and phenylacetic aldehyde. For the clove pink compounds a fairly large percentage of *amboyna* clove oil is of considerable value. Other bodies of recent introduction are hexyl methyl ketone and amyl oxyiso-eugenol, and the addition of some of them to the foregoing improves the odour. The best blends are obtained by the employment of rose and orange blossom absolutes, neroli, ylang-ylang, and heliotropin, while the fixation of the otto is completed by the addition of about 10 per cent of benzyl iso-eugenol. This article is now readily available and is enjoying a much wider application with experienced perfumers ; if it is not available, benzoin or any of the other listed fixatives may be used in its place. The oils of black pepper or pimento aid the correct reproduction of the carnation odour, and supply that peculiar liveliness characteristic of the flower. Phenyl propyl aldehyde, decyl aldehyde and mere traces of C_{16} are used for enhancing the finished compound. Carnation oils are now employed on a wide scale for blending unfinished perfumes. A violet, based upon methyl ionone, makes an effective counterpart, especially if fixed with ambrone, No. 1007.

Synthetic Components :—

Bases.—Iso-eugenol, eugenol, amyl salicylate, phenylacetic aldehyde, amboyna clove oil, pimento oil, amyl oxyiso-eugenol.

Blenders.—Methyl iso-eugenol, methyl eugenol, hexyl methyl ketone, iso-butyl and iso-amyl phenylacetates, benzyl acetate, phenylethyl alcohol, black pepper oil, bois de rose oil, bergamot oil, nutmeg clair, eugenyl formate, cardamon oil, heliotropin.

Modifiers.—α-Ionone, hydroxy-citronellal, ylang Manila, mace concrete, terpineol, orris, geranyl acetate, benzaldehyde.

Fixers.—Benzyl iso-eugenol, benzyl salicylate, acetyl iso-eugenol, ethyl protocatechuic aldehyde, vanillin, ketone musk, benzoin R., clary sage, civet, vanilla, cinnamic alcohol, musk.

Florales. — Neroli, rose, orange blossom, jasmin, tuberose.

Aldehydes.—Phenyl propyl aldehyde, C_{16}, C_{10}.

The following formulæ will yield endless possibilities :—

Carnation, No. 1021.

200	Iso-eugenol.
100	Benzyl iso-eugenol.
10	Carnation absolute.
50	Heliotropin.
20	Rose otto virgin.
30	Petitgrain oil—terpeneless.
100	Ylang-ylang oil—terpeneless.
10	Phenylacetic aldehyde.
300	Eugenol.
30	Amyl salicylate.
40	Jasmin colourless, No. 1055.
18	Nutmeg clair.
1	Phenyl propyl aldehyde.
1	10 per cent solution C_{16}.
10	Vanillin.
20	Hydroxy-citronellal.
30	Terpineol.
30	Iso-butyl phenylacetate.
1000	

Clove Pink, No. 1022.

250	Iso-eugenol.
150	Amboyna clove oil.
40	Rose absolute.
100	Pimento oil, terpeneless.
10	Cassia oil.
30	Nerol.
60	Amyl salicylate.
100	Hexyl methyl ketone.
20	Cananga oil, terpeneless.
20	Musk ketone.
100	Benzoin R.
50	Heliotropin.
20	Coumarin.
20	Vanillin.
1	Phenyl propyl aldehyde.
19	Black pepper oil.
10	Clary sage oil.

Alcoholic Perfumes may be prepared as follows :—

No. 1023.

70	Carnation, No. 1021.
10	Jasmin absolute.
10	Musk extract, 3 per cent.
10	Benzoin R.
900	Alcohol.
1000	

or compounded direct :—

No. 1024.

20	Œilletophyx, No. 1009.
5	Orange blosson absolute.
10	Jasmin absolute.
4	Rose ,,
1	Tuberose absolute.
20	Vanilla extract, 10 per cent.
17	Amboyna clove oil.
5	Methyl iso-eugenol.
3	Ylang-ylang oil, terpeneless.

1	Methyl ionone.
1	Geranyl acetate.
2	Iso-butyl salicylate.
1	Mace oil.
1	Phenylacetic aldehyde.
4	Heliotropin.
5	Benzyl iso-eugenol.
900	Alcohol.
1000	

CASSIE.

History.—*Acacia Farnesiana* is a small tree whose origin appears to be uncertain. It is said to be a native of San Domingo and became naturalised in Europe in the Farnesian gardens at Rome about 1656, but this date is probably incorrect since it is referred to by the author of a book published in Rome in 1625, entitled "Albini Hort. Farnesiana." About 1764 Linnæus, in "Hort. Upsalensis," described and named it *Mimosa Farnesiana*, which was afterwards, by Willdenow (1805), placed in his genus *Acacia*.

Varieties.—There are several species of acacia which yield the typical cassie blossom odour. The more important of these are *Acacia Farnesiana*, Willd. (ancient cassie) and *A. Cavenia*, Hook. et Arn. (Roman cassie), both being cultivated in the south of France. The former is also cultivated in Syria, while it thrives in the Philippines, North and South America, India, Australia, Angola, Tunis, Egypt, and the West Indies; *A. Giraffæ* (the Camel tree) and *A. horrida* flourish in South-West Africa.

Cassie trees were first grown in the south of France at Cannes, then at Vallauris and Le Cannet. Owing to the increased popularity of Cannes as a winter resort large hotels and residences have been built on the fields once occupied by these trees, and consequently in recent years cultivation has moved further afield to Golfe-Juan, Mougins, and St. Laurent-du-Var.

The ancient and Roman cassie resemble one another, but the perfumes of the former is much finer, and thus the flowers command about twice the price of those of the latter. The difference in the appearance of the two will be readily appreciated by a reference to the photographs opposite. Both plants are affected by atmospheric conditions, but *A. Cavenia* has the advantage in being much less sensitive and requiring less attention during cultivation. Both require a sunny situation and protection from the cold winds; they thrive best on a light sandy granite soil. *A. Farnesiana* is grown from seed and *A. Cavenia* from cuttings, both being planted out during the month of March. The former must be pruned every year, in the spring, but only old and useless branches are removed in the latter. Nowadays *A. Farnesiana* is often grafted directly upon the hardier *A. Cavenia.* If the wood of these trees is destroyed by frost grafting again takes place on the shoots. In a couple of years the harvest becomes normal.

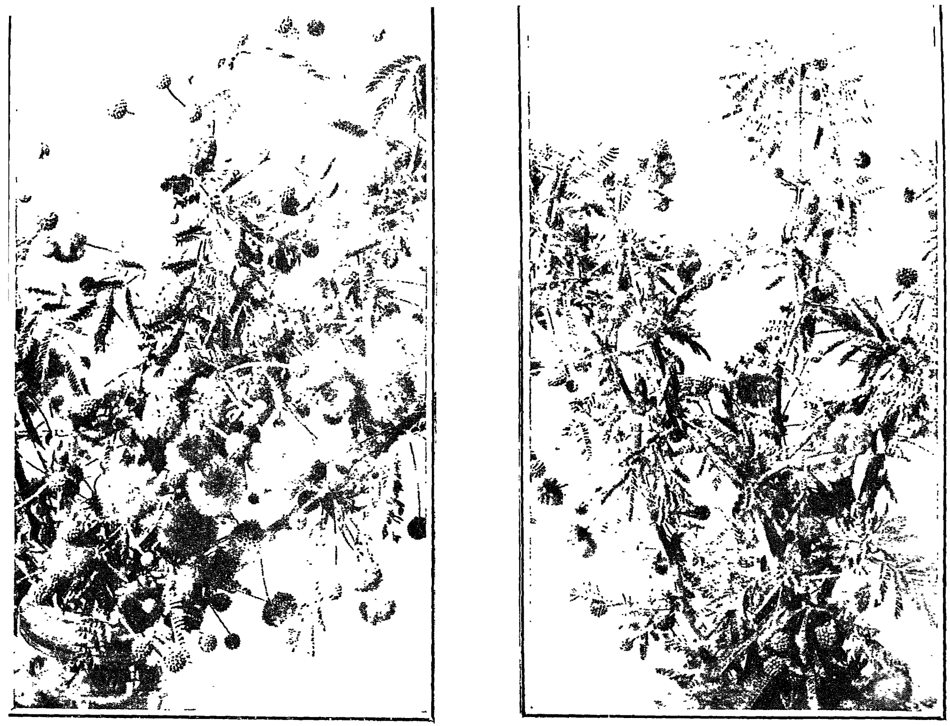
A. Farnesiana blossoms from the end of September to the beginning of February. Abundant crops are obtained if the temperature has been mild and moist. The trees are then trimmed.

A. Cavenia generally yields two crops each year, the first being collected at the same time as the above, and the second in the spring, sometimes as late as May.

According to a French periodical [1] out of five crops one is good, one is fairly good, two are medium, and one is absolutely nil.

The cassie blossoms (sometimes known locally as "Pompons") are generally harvested by women, and great care is necessary during collection. The trees grow to a height of about 15 feet, and the blossoms are successive, some being ready for collection before others are scarcely formed. The flowers are gathered twice a week, in the daytime, and are conveyed to the works in the evening—the yield of blossoms per tree being from 2 to 5 kilos.

[1] "Les Parfums de France" (1924), 336.



[*A. Chiris.*

FIG. 31.—The two principal varieties of Cassie.

[*To face page* 102.

Odour.—The species mentioned above bear golden globular flowers, whose perfume closely resembles a perfectly blended combination of orange blossom and violet with just a mere suggestion of cummin. As already stated those of *A. Cavenia* are not so fine.

Natural Perfume.—Cassie flowers are extracted by means of hot fats or by volatile solvents, and the absolute flower oil is prepared from both pomade and concrete. The latter process is now almost exclusively employed. About 250 kilos of flowers produce 1 kilo of concrete which in turn yields about 300 grams of absolute.

According to A. Ruppin,[1] the flowers cultivated in Syria are not extracted by the above method, but the floral odours are absorbed by means of plates of spermaceti which are sent to France to be worked up into perfumes.

In practical perfumery cassie absolute enters largely into the preparation of numerous violet bouquets, and to these it imparts a delightful and peculiar fragrance unobtainable with any other product. In this connection it should be noted that when compounding synthetic violet ottos, the use of some natural violet absolute is recommended, but owing to its prohibitive cost something cheaper often has to be found to replace it. Cassie absolute is a good substitute, and about 5 per cent may be used with satisfactory results.

Chemistry.—During the past twenty years practically no research work on this essential oil has been published. Prior to 1904 it had been studied by Schimmel & Co., von Soden, and Haarmann and Reiner, who identified the following constituents :—

Methyl salicylate.	Anisaldehyde.
Benzyl alcohol.	Benzaldehyde.
Farnesol.	Cuminic aldehyde
Linalol.	Decyl ,,
Geraniol.	

[1] Schimmel's "Report" (1917), 106.

Traces of *p*-cresol exist and also two undefined ketones, one resembling menthone and the other having an odour recalling violet.

In cassie Romaine, Walbaum also found some eugenol and methyl eugenol.

Compounding Notes.—An artificial cassie may easily be built up from the known constituents mentioned above, but great care must be taken in the use of methyl salicylate, and the proportion should not exceed 25 per cent. This synthetic can be replaced by iso-butyl salicylate, if desired. Cuminic aldehyde or oil of cummin, although used in small proportions, may almost be classified as basic constituents owing to their odour being so closely associated with that of cassie. The higher aldehydes are all used in small proportions, and several pleasant modifications can be made by the employment of duodecyclic aldehyde. Of the violet-smelling ketones irone is best, then methyl ionone, and lastly beta ionone. Geraniol, benzyl alcohol, and linalol make excellent blenders for the otto, and traces of their *butyrate* will assist in producing odours having a close resemblance to the natural product. A very pleasant floral note may be struck by the use of para-methyl acetophenone (traces), and the suggestion of orange blossom can, of course, be obtained with methyl anthranilate or methyl naphthyl ketone. Fixation may be accomplished with oleo-resin orris, violettophyl or any of the other bodies outlined in the classified list and floweriness of the odour can be attained by the addition of some cassie absolute.

Synthetic Components:—

Bases.—Methyl salicylate, iso-butyl salicylate, cuminic aldehyde, cummin oil.

Blenders.—Linalol, bois de rose, benzyl alcohol, petit-grain oil, ionones, benzyl acetate.

Modifiers.—Anisic aldehyde, cinnamyl butyrate, methyl anthranilate, geraniol, geranyl butyrate, benzyl butyrate, linalyl butyrate, methyl heptine carbonate, orris concrete, bergamot, methyl naphthyl ketone, anisyl acetate.

Fixers.—Orris oleo-resin, costus, styrax, tolu, coumarin, vanillin, ethyl phthalate.

Florales.—Cassie, violet leaves, orange blossom.

Aldehydes.—C_{12}, phenyl propyl aldehyde, C_{10}.

Type formulæ are given :—

Cassie, No. 1025.

250	Benzyl alcohol.
80	Geraniol.
155	Linalol.
200	Iso-butyl salicylate.
40	Anisic aldehyde.
80	Irone.
2	Aldehyde C_{12}.
50	Methyl anthranilate.
5	Methyl acetophenone.
60	Violettophyx, No. 1010.
30	Cassie absolute.
23	Cuminic aldehyde.
10	Cinnamyl butyrate.
5	Violet leaf absolute.
10	Methyl heptine carbonate.
1000	

No. 1026.

240	Methyl salicylate.
120	Beta ionone.
40	Orris oil, concrete.
200	Benzyl alcohol.
75	Bois de rose oil.
5	Cummin oil.
50	Anisic aldehyde.
75	Petitgrain oil, terpeneless.
80	Palmarosa oil.
5	Rhodinyl butyrate.
10	Aldehyde C_{10} (10 per cent solution)
25	Orris oleo-resin
25	Coumarin
50	Styrax R.
1000	

Alcoholic Perfumes may be prepared thus :—

No. 1027.

80	Cassie, No. 1025.
10	Civet extract, 3 per cent.
10	Orange flower absolute.
900	Alcohol, 90 per cent.
1000	

or compounded direct :—

No. 1028.

10	Cassie absolute.
3	Orange blossom absolute.
1	Violet absolute.
2	Rose ,,
16	Methyl salicylate.
20	Bois de rose oil.
5	Linalol.
1	Cinnamyl butyrate.
1	Cuminic aldehyde.
1	Violet leaves absolute.
10	Bergamot oil.
10	Methyl ionone.
920	Alcohol.
1000	

CHYPRE.

Strictly speaking, chypre perfumes are "flowery" rather than "flower" perfumes, and should not therefore be included in this series of monographs. Their importance to-day, however, commands a place, hence these notes.

History.—The island of Cyprus is known to the French as Chypre, and the perfume appears to have originated in this island. There is no clear record as to dates, although it was in the twelfth century, at the time of the Crusades, that Richard I of England assumed the title of King of Cyprus, and, according to Piesse, eau de chypre was then introduced to Europe. Before this time the island was patronised largely by the elite of adjacent countries, such as Italy, Greece, Persia, and Egypt, and in view of the importance there of cistus plants (labdanum), it would not be surprising that a perfume should have been made with this still much-esteemed material. According to Lazare,[1] the word chypre was first given to a perfume in the fourteenth century, when "oyselets de chypre" or "cypre" were composed of labdanum, styrax, and calamus, made into a paste with tragacanth and then moulded in the form of a bird. They were very popular on the Continent, and were burned much in the manner as pastilles are to-day. The first notable modification in the basic composition of the perfume occurred towards the end of the fourteenth century when oakmoss was added. Dejean's "Traité des Odeurs," 1777, gives two recipes for chypre. The first contains white, washed oakmoss in powder, with musk, ambergris, and civet. The second is more elaborate, containing oakmoss, orange flowers, benzoin, storax, civet, almonds, cardamon, roses, clovewood, santal, and camphor.

Modern Odour Type.—This varies very much in character according to the fancy or creative taste of the artist composing the perfume. The substances common to all are oakmoss, patchouli, santal, and vetivert.

Compounding Notes.—Chypre perfumes are generally classified as belonging to the heavy, very clinging type, and curiously enough are much favoured by masculine taste. Oakmoss, in the form of green or decolorised absolute, is usually employed as one of the basic constituents, although many of the older established firms still use an alcoholic tincture of 10 per cent powdered oakmoss. More recently an oil has appeared which is the product of the distillation of the lichen with cedarwood oil. Other basic substances are either the oils or resinoids of patchouli (extra quality), santalwood, and vetivert (Java). The blenders consist mainly of orris, calamus, clary sage, tarragon, and angelica. These have very powerful odours and are, therefore, used

[1] "Les Parfums de France" (1925), 6.

in small quantities. The modifiers comprise ionones, ylang, bois de rose, iso-eugenol, amyl salicylate, and cinnamyl esters. Flowery notes are obtained with jasmin, rose, and cassie—the rose as a rule predominating. A difficulty which has to be overcome in the heavy type of perfume is to give it sweetness and lift, and for this purpose liberal additions of the citrus oils are imperative. Other helpful additions are cinnamon, pimento, and sassafras. The fixation of the odour is of course, strictly speaking, unnecessary, owing to the tenacious nature of the basic constituents. However, the substances usually regarded as fixatives contribute more in this case as modifiers and comprise musks, coumarin, vanillin, dimethyl hydroquinone, benzoin, styrax, labdanum, and castoreum.

Synthetic Components :—

Bases.—Oakmoss, patchouli, santalwood, vetivert.

Blenders.—Cypress, cedarwood, orris, calamus, clary sage, angelica, tarragon, tagete (marigold), heliotropin.

Modifiers.—Ionones, ylang and cananga, rosewood, clove, iso-eugenol, amyl, iso-butyl and methyl salicylates, esters of cinnamic alcohol, cinnamon, sassafras, pimento, bergamot, lemon, mandarin.

Fixers.—Musks, coumarin, vanillin, labdanum, castoreum, civet, musk, dimethyl hydroquinone, styrax.

Florales.—Rose, jasmin, cassie.

Aldehydes.—C_8, C_{10}, gamma undecalactone.

Formulæ illustrating these components follow :—

Chypre, No. 1029.

50	Oakmoss absolute—green.
50	Patchouli oil extra.
50	Vetivert oil—Java.
140	Sandalwood oil—E.I.
90	Iso-butyl salicylate.
70	Methyl ionone.
50	Hydroxy-citronellal.
160	Bergamot oil.
10	Eugenol.

10	Clary sage oil.
5	Coriander oil.
5	Tarragon oil.
2	Sassafras oil.
2	Cinnamon bark oil.
1	Laurinic aldehyde, 10 per cent
10	Neroli oil, petales.
10	Cassie absolute, farnesiana.
50	Jasmin absolute, ether.
50	Rose absolute, benzole.
30	Ambrone, No. 1007.
10	Castoreum absolute.
100	Styrax resinoid.
5	Vanillin.
40	Musk ketone.
1000	

Chypre, No. 1030.

80	Chypre, No. 1029.
5	Rose otto—Bulgarian.
2	Coumarin.
3	Jasmophore.
10	Civet extract, 3 per cent.
900	Alcohol.
1000	

CYCLAMEN.

History.—This plant was known many years before Christ, but classical literature contains no references to its charming odour. There are, however, some interesting points in connection with its supposed medicinal value. Theophrastus calls attention to the properties of *Cyclamen græcum* as follows[1]: "Of cyclamen the root is used for suppurating boils; also as pessary for women and mixed with honey for dressing wounds; the juice for purgings of the head for which purpose it is mixed with honey and poured in; it also conduces to drunkenness, if one is given a draught of wine in which it has been steeped. They say also the root is a good charm for inducing rapid delivery, and as a love

[1] "Enquiry into Plants," ix., 9, 3.

potion when they have dug it up, they burn it, and then having steeped the ashes in wine, make little balls like those made of wine-lees which we use as SOAP." Pliny[1] discusses the properties of three different cyclamens, but only one of these is considered by commentators to belong to this genus of the N.O. Primulaceæ, i.e. *Cyclamen hederæfolium*, the ivy-leaved cyclamen. The other two are now considered to be respectively the Italian honeysuckle, *Lonicera caprifolium*, and the small lily of the valley, *Convalleria bifolia*. Pliny calls the cyclamen "tuber terræ," and while attributing to it many of the properties already mentioned by Theophrastus, states that when kept in the house noxious smells have no effect, and further that if a pregnant woman steps over the root she will be sure to miscarry!

The common name for cyclamen is Sowbread. It appears that in Italy and Sicily where the plant is fairly common, the fleshy rootstock (corm) is much appreciated by swine, hence the name *Pane porcino*.

Varieties.—The cyclamen is easily recognised from its reflexed corolla. The plants are found growing wild in sub-alpine regions and in this country are much cultivated in greenhouses; hence the name "cyclamen des Alpes."

C. Europæum is one of the best-known species with its reddish-purple flowers. According to F. A. Hampton[2] the plant is so much at home in this country that it is naturalised in several woods. The blooms appear from August to November, and a corm 20 years old is said to bear as many as one hundred flowers.

C. coum is native to Southern Europe. Flowers rose or white appearing in February or March.

C. neapolitanum (*græcum*). Rose or white flowers with purplish tints at reflex point. Blossoms appear August to October.

C. repandum (*hederæfolium*). Ivy-leafed cyclamen. Rose-red and white flowers appearing from March to May,

[1] Book XXV, chapters 67, 68, and 69.
[2] "P. and E.O.R." (1925), 252.

FIG. 32.—Cyclamens. [*Sutton & Sons.*

[*To face page* 110.

common in Central Europe and Northern coast of Africa. Corm not infrequently 10-12 inches in diameter, covered with cracked or scaled brownish rough rind.

Natural Perfume.—This is not an article of trade, and there appears to be no record of any attempts to extract it commercially. Experimentally, however, cyclamen has received some attention from F. Elze,[1] who macerated the flowers (species not stated) with liquid fat and obtained therefrom an extract by means of petroleum ether. After treatment with alcohol a dark coloured absolute was obtained in which this chemist identified, with certainty, nerol and farnesol. He states also that ketones, aldehydes, phenols, and esters were present. The perfume of the flowers vary slightly. It is most powerful in *C. persicum*, and recalls a blend of lily-lilac and violet, with occasionally a suggestion of hyacinth.

Compounding Notes.—The odour of cyclamen is too complex to suggest any one synthetic substance as a base, but a blend of terpineol, hydroxy-citronellal, and ionone will supply the lily-lilac-violet odour which can easily be blended and modified to the experimenter's own taste. Linalol represents the best blender supported by any of the other rose alcohols. Concrete orris will add substance to the violet note, while artificial neroli, French petitgrain or geranyl formate will enhance the lilac base. The hyacinth modification is best obtained with phenylacetic aldehyde, but variations may be made with cinnamic alcohol, styrolene acetate, and phenyl propyl alcohol. The musky odour noticed in some species is obtained with either natural musk, or ketone musk and benzoin. These substances will also act as fixatives; other useful articles are benzoin and styrax. The floral character may be imparted by the use of almost any of the flower absolutes. Of the aldehydes, premier place is taken by para-iso-propyl alphamethyl hydrocinnamic aldehyde, this body possessing an intense odour of the flower.

[1] "Riechstoffindustrie," 3 (1928), 91.

Synthetic Components:—

Bases.—Terpineol, hydroxy-citronellal, alpha ionone, methyl ionone.

Blenders.—Linalol, bois de rose oil, geraniol, nerol, bergamot, sweet orange, concrete orris, geranyl formate, benzyl acetate, phenylethyl alcohol, benzyl alcohol, methyl anthranilate, phenoxy ethyl iso-butyrate.

Modifiers.—Phenylacetic aldehyde, cinnamic alcohol, styrolene acetate, α-bromstyrol, ylang-ylang, methyl heptine carbonate, anisic aldehyde, amyl salicylate, farnesol, heliotropin.

Fixers.—Vanillin, coumarin, musk ketone and ambrette, benzoin, styrax, vanilla musk, ambrone, olibanum.

Florales.—Neroli, jasmin, rose, tuberose, jonquille.

Aldehydes.—C_{14}, C_{10}, iso-propyl alphamethyl hydrocinnamic aldehyde.

Representative formulæ are given:—

Cyclamen, No. 1031.

300	Hydroxyl-citronellal.
100	Terpineol.
90	Methyl ionone.
100	Linalol.
60	Bergamot oil.
70	Benzyl acetate.
15	Phenylacetic aldehyde.
45	Cinnamic alcohol.
5	Ylang-ylang oil—Manila.
100	Neroli, No. 1081.
10	Rose otto.
10	Jasmin absolute.
20	Tuberose ,,
1	Gamma undecalactone.
3	Iso-propyl alphamethyl hydrocinnamic aldehyde.
1	Decyl aldehyde.
10	Concrete orris.
25	Heliotropin.
5	Vanillin.
30	Ketone musk.
1000	

Alcoholic Perfumes may be usefully prepared from the artificial cyclamen and toned up by further additions of natural extracts as follows :—

Cyclamen, No. 1032.

70	Cyclamen, No. 1031.
8	Musk extract, 3 per cent.
2	Exaltolide, 10 per cent.
3	Jonquille absolute.
5	Rose ,,
10	Jasmin ,,
2	Cassie ,,
900	Alcohol.
1000	

FERN.

History.—Ferns have been known from time immemorial and are mentioned fairly frequently in classical literature. A number of them are described and compared by Theophrastus, but he makes no mention of any pleasant smelling varieties. He draws attention to both white and black maiden-hair—called wet-proof—because it does not catch the dew nor get wet when watered. It was found growing in damp places, and when pounded up and mixed with olive oil was used by the Greeks to prevent hair falling out. Other ferns mentioned by this author are—bracken, *Pteris aquilina ; nephrodium felix-mas* and heart's tongue, *Scolopendrium vulgare.* Pliny mentions two kinds which are equally destitute of blossom and of seed. One of these, he says, has a root with a not unpleasant smell. He describes fully the anthelmintic properties of the male fern. The common bracken has in the past been much esteemed. The cut and dried fronds have been used for domestic purposes. The underground stems contain a quantity of mucilage and starch which in some parts of Europe and Northern countries are prepared by washing and pounding and are mixed with meal to make bread in times of scarcity. At one time a distinct species, *Pteris esculenta,* formed an important item of food to the natives of the

Pacific Islands. According to John Smith[1] the fern is burnt in large quantities in Wales, and the ashes, which contain a considerable quantity of alkali, mixed with water and made into balls are sold in towns as a substitute for soap, under the name ash-balls. The absence of visible flowers and seeds on ferns has attached much superstition to these plants. In Shakespeare's time they were spoken of as "uncanny and evil," and it was considered that those who possessed fern seed could make themselves invisible at pleasure. A more practical notion, says Smith, of the supposed power of ferns is, that the burning of it brings down rain, of which the following is a curious illustration. In a volume containing a miscellaneous collection by Dr. Richard Pocock, in the British Museum, is the copy of a letter written by Philip Herbert, third Earl of Pembroke, Lord Chamberlain to the Sheriff of Staffordshire. It is as follows: "Sir, His Majesty, taking notice that the burning of Ferne doth draw down rain, and being desirous that the country and himself may enjoy fair weather as long as he remains in these parts, His Majesty has commanded me to write to you to cause all burning of Ferne to be forborne until His Majesty be past the country. Wherein, not doubting but the consideration of their own interest as well as of His Majesty's will invite the country to a ready observance of this His Majesty's commands. I rest, your very loving friend, Pembroke and Montgomery."

Varieties.—Ferns, having no true flowers, belong to the division of plants known as Cryptograms, the natural order of this particular branch being *Felicineæ*, of which nearly 3000 species have been named and described. They are widely distributed over the globe and vary in size and form from a small plant to a lofty tree of 50 feet in height terminated by a crown of finely-cut leaves, termed fronds, varying in length, and sometimes in the larger species exceeding 15 feet. Reproduction is by means of spores, generated on the under side of the fronds. Commercially the most important species is male fern, *Dryopteris Felix-*

[1] "Economic Plants" (1882), 59.

mas, abundant in Britain and one of the commonest of our indigenous ferns. The rhizome is collected in the autumn, and the fronds and roots removed. It is dried and subsequently extracted with volatile solvents. This fern is common also in Germany and the Harz Mountains. The extract is, as is well known, used medicinally and to some extent in Fougère perfumes. Other interesting ferns are:—

Adiantum amabile.—Scented maiden-hair—an elegant stove fern from Brazil. Young specimens have a pleasant fragrance.

Asplenium fragrans, growing wild in North America, fronds dried and used as bedding.

A. Onopteris and *A. Obovatum*, common to the shores of the Mediterranean and particularly the Esterel.

Osmunda regalis, common to bogs, woods, and wet meadows in Europe.

Other species found in sheltered parts of the South of France are *Polypodium vulgare* and *Scolopendrium officinale.*

Odour.—The fern odour is well known and much suggestive of oakmoss and patchouli.

Chemistry.—The natural perfume is an article of commerce, though to perfumers not very common since they generally prefer to base Fougère perfumes upon oakmoss and patchouli. The male fern rhizome contains about 5 per cent of *Filmarone*, a yellow, amorphous substance of acid nature, to which the vermifuge properties of the drug appear to be attributed. The volatile solvent extract contains in addition aspidinol, flavaspidic acid, flavaspidinol, albaspidin, and filicitannic acid. It should be of a greenish rather than a brownish colour.

Compounding Notes.—Fougère perfumes are very much akin to chypre compositions, but of rather a lighter note. They are based almost exclusively upon oakmoss modified with patchouli, coumarin, and vanilla. Excellent blenders are to be found in lavender, bergamot, bois de rose, and ylang-ylang, while the flowery note may be obtained successfully with rose, cassie, tuberose, and jasmin. The base itself is such an excellent fixative that others take a secondary place. These include the crystalline synthetics, together with natural civet, castor, and musk.

Synthetic Components:—

Bases.—Oakmoss absolute and oil, fern absolute.

Blenders.—Lavender, bergamot, petitgrain, ylang-ylang, linalyl iso-butyrate, bornyl acetate, eucalyptus, rose geranium, ambrone, tonka bean extract, cedarwood, clary sage.

Modifiers.—Patchouli, vetivert, coumarin, vanilla, amyl salicylate, anisic aldehyde, ionone, sassafras, sandalwood, benzyl propionate, methyl benzoate, methyl acetophenone, methyl salicylate, tarragon, heliotropin.

Fixers.—Musk ketone and ambrette, vanillin, benzophenone, myrrh, acetanisol, dimethyl hydroquinone, musk, castoreum, civet.

Florales.—Rose absolute and otto, cassie, tuberose, jasmin.

Aldehydes.—C_{11}, C_{13}.

Formulæ illustrating these components follow :—

Fougère, No. 1033.

150	Bergamot oil.
50	Lavender oil.
30	Ylang-ylang oil—Manila.
80	Geranium oil over roses.
40	Oakmoss absolute, decolorised.
10	Patchouli oil.
10	Vetivert oil—Java.
100	Vanilla extract, 10 per cent.
60	Alpha ionone.
30	Amyl salicylate.
5	Tarragon oil.
150	Rose, No. 1090.
170	Jasmin, No. 1053.
10	Tuberose absolute, from pomade.
5	Aldehyde C_{11}, 10 per cent solution.
50	Coumarin.
30	Musk ketone.
20	Heliotropin.
1000	

Alcoholic Perfumes may be prepared direct from the above compound as follows :—

No. 1034.

50	Fougère, No. 1031.
15	Musk extract, 3 per cent.
15	Civet " "
10	Ambrone, No. 1007.
3	Rose absolute.
4	Jasmin "
2	Cassie "
1	Tuberose "
900	Alcohol.
1000	

GARDENIA.

Botany.—The gardenia, as generally known in this country, is the flower of *Gardenia Florida L.*, a shrub belonging to the N.O. Rubiaceæ, and native to tropical Asia and South Africa. The genus was named in honour of Dr. Garden, of Charleston, California, a correspondent of Linnæus, and consists of numerous species, all of which bear beautiful and highly fragrant flowers. Amongst these may be mentioned :—

G. Florida, known also as Cape jessamine, has double white flowers, fragrance reminds of jasmin, with trace phenyl methyl carbinyl acetate. Known in China as pak-sema-hwa and used for scenting tea. Berry orange coloured, and size of pigeon's egg. Pulp used in Far East for dyeing yellow.

G. Radicans, native of Japan. Dwarf free blooming variety.

G. Calijculata, native of mountains in India, large white flowers. In Bengal known as gundhuraja.

G. Costata, known also as *G. Coronaria*, tree of 25 feet high, large salver-shaped flowers, tube 3 inches long, border 4 inches diameter. First grown Botanic Garden of Calcutta.

G. Grandiflora, large white flowers. Native Cochin China on banks of rivers.

G. Tomentosa, native of Java.

G. Devoniana, native of Sierra Leone.

G. Citriodora, odour recalls syringa and orange blossom.

G. Thunbergia like *G. Floribunda*, native of South-West Africa.

G. Gummifera and *G. lucida*, native of East Indies. Wounding of bark exudes a fragrant resin not unlike elemi.

The species of the genus *Randia* are not unlike gardenias and many of them are highly fragrant.

Guido Mariotti, an Italian professor, has recently been experimenting with the hybridisation of gardenias, and has succeeded in producing thirteen coloured and scented specimens *shaped like roses*.

Odour.—The absolute of gardenia is not a Grasse commercial product, but through the courtesy of Mr. Louis Amic of Roure-Bertrand Fils, the author received a small sample especially prepared from the flowers by means of petroleum ether. This absolute was yellowish-brown in colour, semi-liquid in consistence, and had an odour recalling that of a mixture of the absolutes of jasmin, orange blossom, and tuberose. An odour suggesting phenyl methyl carbinyl acetate could just be detected.

Natural Perfume.—This is now regularly produced in Reunion according to E. Guenther,[1] and was first experimented with by Charles Garnier in 1912. The variety of flower cultivated is not stated, but the gardenia fields are situated at a high altitude where moisture is favourable to growth and cyclones are ineffective. There are roughly 7000 plants per hectare. Cuttings are placed over one metre apart and a well-developed bush yields from 100 to 260 grams of blossoms per annum. The harvest is collected in November and December. Extraction with volatile solvents yields the commercial product which is expensive. One kilo of concrete is obtained from 3000 to 4000 kilos of flowers, and this again yields to alcohol about 500 grams of absolute. This product even after

[1] "American Perfumer" (January, 1935), 558.

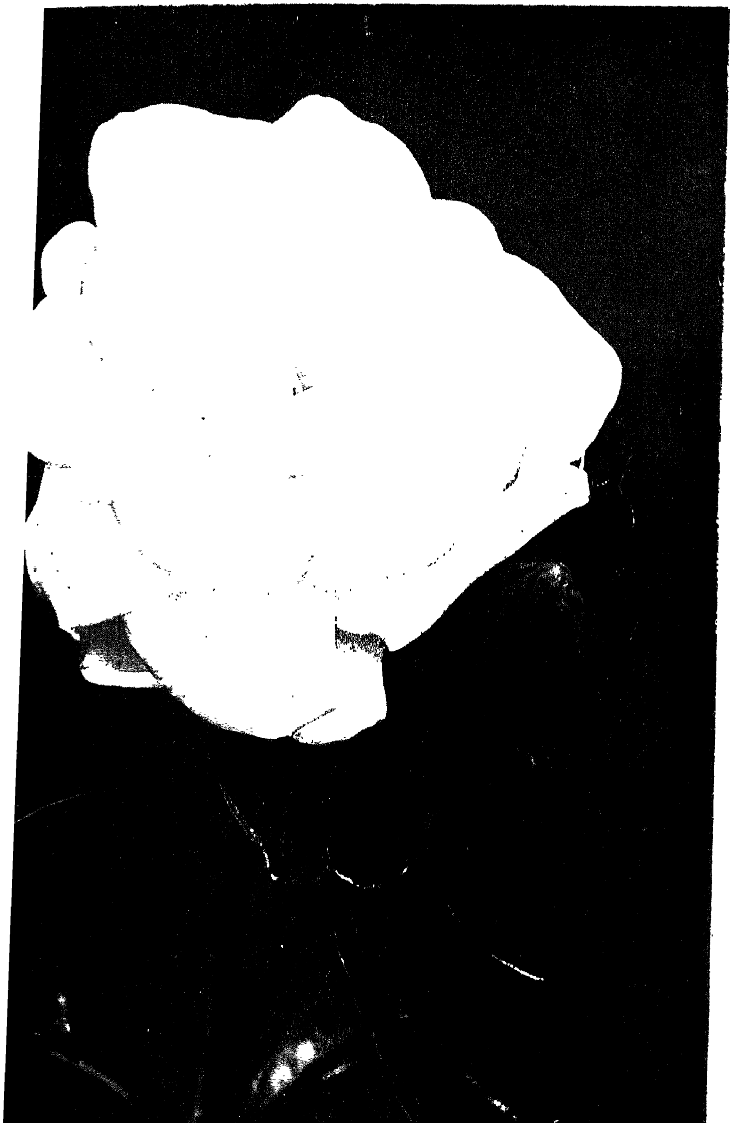


FIG. 33.—Gardenia. [R. A. Malby.

[To face page 118.

careful purification by freezing, deposits yellowish-white crystals on the inside of the container. On standing a yellowish semi-waxy mass separates and floats on the surface. The odour bears a close resemblance to that of the natural flower.

Chemistry.—This has been investigated by E. Parone,[1] who treated 250 kilos of fresh flowers by maceration in liquid vaseline oil and shook out the essential oil with absolute alcohol, obtaining a yield of 176 grams having a yellowish colour. He identified the following constituents: benzyl acetate, styrolyl acetate, linalol, linalyl acetate, terpineol and methyl anthranilate, together with traces of benzoic acid as ester. Although the chief constituent was benzyl acetate, the characteristic odour was due to styrolyl acetate.

Compounding Notes.—In view of the fact that the odour of fresh gardenia flowers suggests a fruity complex of jasmin, tuberose and orange blossom with traces of gardenol, it follows that the basis of the synthesised flower compound will be very much that of the flower odour recalled. The substances which would naturally be selected, therefore, are methyl phenyl carbinyl acetate, benzyl acetate and formate, amyl cinnamic aldehyde and hydroxy-citronellal. These synthetics may be conveniently blended beforehand, when by this means the quantity of gardenol can be much better assessed. The blenders should contain some substances of a fruity nature, such as benzyl iso-butyrate, cyclohexanyl butyrate or nonyl-lactone together, of course, with ylang and the ionones. The modifiers contain, amongst other things, eugenol, phenylacetic aldehyde, methyl octine carbonate, phenylethyl alcohol, heliotropin, linalol and bergamot; terpineol and linalyl acetate being also useful. The fixatives include the artificial musks, coumarin, vanillin, myrrh, tolu and civet. The flowery note is obtained with jasmin, tuberose, orange blossom, mimosa and neroli. Rose otto is useful in exclusive products where price can be obtained. The aldehydes are very much a matter of fancy. A synthetic

[1] "Boll. Chim. Farm.," 41 (1902), 489.

recently introduced and having a decided gardenia note is benzyl amyl ether, but most perfumers limit its use to that of soaps.

Synthetic Components :—

Bases.—Phenyl methyl carbinyl acetate, benzyl acetate and formate, amyl cinnamic aldehyde, hydroxy-citronellal, benzyl amyl ether.

Blenders.—Benzyl iso-butyrate, benzyl phenylacetate, cyclohexanyl butyrate, gamma nonyl-lactone, ylang, ionones, heliotropin.

Modifiers. — Eugenol, acetyl iso-eugenol, phenylacetic aldehyde, methyl octine carbonate, linalol and esters, terpineol and esters, phenylethyl alcohol and esters, bergamot.

Fixers.—Musks, coumarin, myrrh, tolu, civet, ambrette absolute.

Florales.—Jasmin, tuberose, orange blossom, mimosa, rose otto.

Aldehydes.—C_8, C_9, C_{10}.

Formulæ illustrating the use of these substances are appended :—

Gardenia, No. 1035.

30	Phenyl methyl carbinyl acetate.
100	Benzyl acetate.
40	Amyl cinnamic aldehyde.
150	Hydroxy-citronellal.
30	Gamma nonyl-lactone.
70	Ylang oil—Bourbon.
100	Alpha ionone.
35	Acetyl iso-eugenol.
15	Phenyl acetaldehyde.
100	Linalol.
100	Bergamot.
30	Musk ketone.
10	Coumarin.
100	Heliotropin.
20	Tolu balsam.
10	Civet absolute.
30	Jasmin „
20	Orange blossom absolute.
5	Aldehyde C_8, 10 per cent.
5	Aldehyde C_{10}, „

Gardenia, No. 1036.

80	Gardenia, No. 1035.
5	Mimosa absolute.
15	Phenylethyl alcohol.
900	Alcohol.

HAWTHORN.

History.—May blossom, *Cratægus oxycantha*, of the N.O. Rosaceæ, has been known since the earliest times, and was mentioned by Theophrastus as growing on Mount Ida. It was regarded by the Greeks as a tree of fortune, while the Romans used it as a symbol of marriage. Its flowering branches are said to have been borne aloft at their weddings, and the newly-wedded pairs were even lighted to their nuptial chambers with torches of its wood. May Day has for years been one of our rural festivals, and many a pretty scene must have been enacted in London during the time of Robin Hood and Friar Tuck, for we are told[1] that the doors were decked with hawthorn and that fantastic dancers performed their antics round the maypole. There was so much enthusiasm at this period that young men and maidens went to the fields at sunrise to wash their faces in the dew and gather the treasured may.

The hawthorn has a traditional connection with the royal House of Tudor. When Richard III was slain at Bosworth Field, a small crown of gold which he wore as a crest on his helmet was found by a soldier on a bush of hawthorn. It was brought to the newly-made King Henry VII, the first royal Tudor, on whose head it was placed when the army saluted him as their sovereign. It is said that in memory of this event the House of Tudor assumed the device of a crown in a bush of fruited hawthorn.

[1] Donald McDonald, "Fragrant Flowers and Leaves" (1895),

Varieties.—There are about forty species of this attractive genus of shrubby trees, which are widely spread over both hemispheres. The height attained by them is about 20 feet, and they live to a great age. The main floral distinctions are colour and single or double flowers, while there is also a variation in the tint of the fruits. The common white-may of our English hedgerows is the most fragrant, and is not approached by the variety with scarlet flowers, which occasionally emit a disagreeable odour. The early spring variety, sometimes called the glastonbury thorn, is known to have flowered just after Christmas, when the atmospheric conditions have been favourable. Another variety, *C. crusgalli*, known as the cockspur thorn and coming from North America, attains a height of about 10 feet only and is remarkable for its peculiar growth. This is particularly noticeable in *C. pyracanthifolia* where the branches spread out like a table. The older the tree, the more pronounced this feature becomes. Another species, *C. aronia*, is common in Palestine, and particularly near Jerusalem, where its red, fleshy fruits are collected for preserves.

Odour.—The exquisite fragrance of the hawthorn is so well known that it requires very little comment. The odour is spicy and recalls that of almonds. The natural perfume is not an article of commerce.

The odour of hawthorn blossom is almost duplicated in the following :—

Erica arborea.
Pyrus communis.
Sorbus aucuparia.
Viburnam tinus.

In all these the presence of anisic aldehyde would seem to be indicated, but so far no chemical proof has been deduced.

Compounding Notes.—The perfume of may blossom is well represented by anisaldehyde, and to a lesser extent

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FIG. 34.—Cratægus Oxyacantha.

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by acetophenone. The former can be used up to 40 per cent in any composition, but the latter should not exceed about one-tenth of that amount. These bases are blended with linalol or one or other of the rose alcohols, while the almondy note is enhanced by judicious additions of benz-aldehyde or para-methyl acetophenone. Modifiers such as ylang-ylang and neroli are generally preferred. Special floral notes are produced by the addition of jasmin and orange flower absolutes, while fixation is effected by utilising coumarin, benzoin, styrax, or dimethyl hydro-quinone.

Synthetic Components :—

Bases.—Anisic aldehyde, anisyl formate, anisic alcohol, anisyl acetate, acetophenone.

Blenders.—Linalol, citronellol, geraniol, nerol, phenyl-acetic aldehyde, amyl salicylate, benzaldehyde or bitter almond oil, S.A.P. bergamot.

Modifiers. — Petitgrain, neroli, ylang Bourbon, alpha ionone, hydroxy-citronellal, iso-butyl phenylacetate, nonyl alcohol, terpineol.

Fixers.—Civet, ketone musk, vanillin, coumarin, ben-zoin, styrax, vetivert, cinnamic alcohol, vanilla, orris oleo-resin, Peru balsam, dimethyl hydroquinone, acetanisol.

Florales.—Rose otto and absolute, jasmin, orange blos-som, cassie, jonquille.

Aldehydes.—C_9, C_{10}.

Two formulæ follow :—

Hawthorn Blossom, No. 1037.

350	Anisic aldehyde.
40	Acetophenone.
100	Geraniol from palmarosa oil
20	Phenylacetic aldehyde.
20	Rose otto.
80	Bergamot.
1	Benzaldehyde (f.f.c.).
30	Jasmin, No. 1053.

Hawthorn Blossom, No. 1037 (*continued*).

80	Petitgrain oil, terpeneless—French.
20	Cassie absolute.
100	Benzoin R.
9	Alcohol C_9, 10 per cent solution.
80	Heliotropin.
10	Dimethyl hydroquinone.
50	Coumarin.
10	Vanillin.
1000	

May Blossom, No. 1038.

400	Aubepine.
100	Linalol.
50	Geraniol.
60	Amyl salicylate.
50	Vanilla extract, 10 per cent.
30	Ylang—Bourbon.
10	Nonyl alcohol.
20	Methyl paratolyl ketone.
20	Orange flower absolute.
10	Orris liquid ,,
20	Rose absolute.
30	Styrax R.
85	Heliotropin.
50	Coumarin.
45	Jasmin absolute, chassis.
20	Ethyl protocatechuic aldehyde
1000	

Alcoholic Perfumes may be prepared from the foregoing as follows :—

No. 1039.

70	Hawthorn blossom, No. 1037.
5	Rose absolute.
5	Tuberose absolute.
20	Amber liquid, No. 1006.
900	Alcohol.
1000	

No. 1040.

60	May blossom, No. 1038.
3	Jonquille absolute.
1	Neroli oil.
10	Civet extract, 3 per cent.
20	Musk ,, ,,
1	Essential oil of almonds—S.A.P.
5	Jasmin absolute, benzole.
900	Alcohol.
1000	

or compounded direct :—

No. 1041.

5	Rose absolute.
3	Jasmin ,,
1	Cassie ,,
1	Jonquille absolute.
15	Anisic aldehyde.
1	Benzaldehyde, 10 per cent solution.
10	Bois de rose oil.
10	Rhodinol.
1	Phenylacetic aldehyde.
25	Bergamot oil.
2	Acetanisol.
10	Musk extract, 3 per cent.
5	Civet ,, ,,
8	Heliotropin.
3	Coumarin.
900	Alcohol.
1000	

HELIOTROPE.

History.—Reference is made to this plant by many ancient writers among whom we may mention Theophrastus and Ovid. We are told by the former that it bloomed for a long period, and that the time of its flowering depended upon the heavenly bodies. The plant was supposed to have owed its existence to the death of Clytie, who pined away in hopeless love of the god Phœbus (Apollo), and the latter (Ovid) alludes to this in the following lines ("Metamorphoses," Book IV, 255-270) :—

"But Clytie, though love could excuse her grief, and grief her tattling, was sought no more by the great light-giver (Apollo), nor did he find aught to love in her.

"For this cause she pined away, her love turned to madness. Unable to endure her sister nymphs, beneath the open sky, by night and day, she sat upon the ground, naked, bareheaded, unkempt.

"For nine whole days she sat, tasting neither drink nor food, her hunger fed by naught save her falling tears, and moved not from the ground.

"Only she gazed on the face of her god as he went his way, and turned her face towards him.

"They say that her limbs grew fast to the soil, and her deathly pallor changed in part to a bloodless plant; but in part 'twas red, and a flower, much like a violet, came where her face had been. Still, though roots hold her fast, she turns ever towards the sun and, though changed herself, preserves her love unchanged."

The plant, whose flowers emit the most delightful fragrance, is *Heliotropium Peruvianum*, belonging to the N.O. Boraginaceæ. It is a native of Peru, and was introduced into Europe about 1757.

Varieties.—The genus *Heliotropium* contains about 90 species, of which the majority are botanically identified. They are distributed over the tropical and sub-tropical regions of both hemispheres and many are found growing in Europe. In England the plant never attains large proportions, but in Southern France it grows to a bush 8 or 10 feet high. The species mentioned above is a favourite for greenhouse cultivation in this country, and the small clusters of its lavender-coloured flowers emit a delightful fragrance, which is somewhat almondy and inclined to be heavy. It is known by a variety of names, including heliotrope, cherry-pie, and Peruvian turnsole, the latter from the ancient fancy that it turned with the sun (*see* Ovid's reference to this above): This plant should not be confused with *Chrozophora tinctoria*, an annual of the N.O. Euphorbiaceæ and native of Southern Europe, where it is

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FIG. 35.—Heliotrope.

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cultivated for the sake of a dye called *Turnsole*. The varieties of heliotrope include the following :—

The Queen, flowers almost white.

Bouquet de Violettes, blooms of different shades of blue.

Bouquet Parfumé, flowers lilac-blue.

Winter heliotrope, *Tussilago fragrans*, is a native of Southern Europe and blossoms early in December. The purple flowers are fragrant and resemble those of *Heliotropium Peruvianum*.

Heliotrope of the lowlands, *Lantana Camara*, *L.* (N.O. Verbenaceæ), is indigenous to tropical South America and has been acclimatised in southern India. In Bombay it is known as "Ghaneri," and the flowers have a sage-like odour.

Odour.—The perfume of the heliotrope, as we have said, is "almondy," and it is probably on this account that the plant received the name cherry-pie. The natural perfume is only occasionally met with in the form of absolute, but the triple extract is sometimes used. This is obtained by macerating the flowers in warm fats, as soon after collection as possible.

Chemistry.—Very little is known of the chemistry of the heliotrope perfume, but in 1876 Haarmann and Tiemann while examining the plant came to the conclusion that its odour was due principally to heliotropin and vanillin. The majority of heliotrope perfumes are, of course, based on these two synthetics and not on the natural heliotrope flower perfume.

Compounding Notes.—The odour of heliotrope is approximated to very closely by heliotropin, which forms the base of all artificial heliotrope compounds. It requires to be developed, however, if a successful preparation is to be marketed, and there is nothing better for the purpose than anisic aldehyde in combination with vanillin. These bodies might, therefore, almost be classified as bases. Peru balsam oil, ylang-ylang oil, and bergamot are the three most useful blenders. The modifiers generally employed are benzaldehyde and eugenol or methyl eugenol. Floral notes may be obtained by the employment of rose, jasmin, and tuberose absolutes, while the tenacity of the perfume can be increased by the addition of cinnamic alcohol, patchouli, ketone musk, or benzoin.

It will be readily observed that the normal constituents of artificial heliotrope make its use in vanishing creams out of the question owing to the grave danger of discoloration, especially when the potted cream is exposed to the sun as so often happens in the shop windows.

Synthetic Components :—

Bases.—Heliotropin, vanillin, anisic aldehyde, anisyl formate.

Blenders.—Bergamot, ylang-ylang, neroli, Peru balsam oil, geraniol, phenylethyl alcohol, phenyl-acetaldehyde, bromstyrole.

Modifiers.—Benzaldehyde, bitter almond oil, tonka bean extract, santal, benzyl formate, amyl cinnamic aldehyde.

Fixers.—Coumarin, musk ketone, cinnamic alcohol, civet, tolu, benzoin, vetivert, vanilla, musk, benzyl cinnamate, patchouli.

Florales.—Rose, jasmin, orange blossom, tuberose.

Aldehydes.—C_9, C_{14}.

Two formulæ follow :—

Heliotrope, No. 1042.

500	Heliotropin.
20	Coumarin.
50	Vanillin.
30	Musk ketone.
3	Benzaldehyde.
20	Rose otto virgin.
10	Jasmin absolute.
5	Tuberose ,,
50	Anisic aldehyde.
100	Bergamot oil.
100	Geraniol from palmarosa oil.
60	Hydroxy-citronellal.
50	Balsam Peru.
2	Gamma undecalactone, 10 per cent.
1000	

Keep in solution by the addition of q.s. benzyl benzoate and store in the dark.

Cherry-Pie, No. 1043.

500	Heliotropin.
50	Vanillin.
30	Ionone alpha.
20	Dimethyl hydroquinone.
30	Cananga oil, terpeneless
100	Rhodinol.
50	Cinnamic alcohol.
100	Peru balsam oil.
50	Anisic aldehyde.
50	Patchouli oil.
20	Benzoin R.
1000	

Keep in solution as above.

Alcoholic Perfumes are made as follows

No. 1044.

50	Heliotropin.
10	Vanillin.
5	Coumarin.
10	Beta ionone.
10	Rose absolute.
2	Tuberose absolute.
3	Jasmin ,,
5	Orange blossom absolute.
4	Ambrone, No. 1007.
1	Anisic aldehyde.
900	Alcohol, 90 per cent.
1000	

No. 1045.

60	Heliotrope, No. 1042.
10	Rose absolute.
5	Neroli oil petale.
5	Ylang-ylang oil—Manila.
10	Musk extract, 3 per cent.
10	Civet ,, ,,
900	Alcohol.
1000	

HONEYSUCKLE.

History.—Among the many unexplained superstitions of by-gone days is the one in connection with the woodbine, for it is stated by ancient writers that the herb-diggers thought they would suffer bodily harm if they did not dig up the roots of this plant before sunrise. Pliny refers to the honeysuckle,[1] saying that the *Clymenus*, as it was then called, was named after the son of Cæneus, King of Arcadia. It had leaves like those of ivy, numerous branches and a hollow stem. The smell of it was powerful and the seed like that of ivy; it grew in wild and mountainous localities. Pliny goes on to say that when taken in drink it cures certain maladies in the male sex, but in doing so it neutralises the generative powers!

The honeysuckle, *Lonicera*, is a twining shrub of the N.O. Caprifoliaceæ, native of the temperate regions of the northern hemisphere and often found growing wild in the hedgerows of England. It is a favourite for planting against our countryside houses and frequently forms a graceful covering for arbours, porches, etc.

A peculiar feature about this plant is that of turning from east to west. The pressure exerted in the course of its twining growth is often sufficient to leave a well-marked indentation on the young trees supporting it.

Varieties.—The genus consists of about 80 species, of which the following may be noted (after D. McDonald):—[2]

L. periclymenum, large creamy flowers, blooming early in the year—perfume most noticeable towards evening.

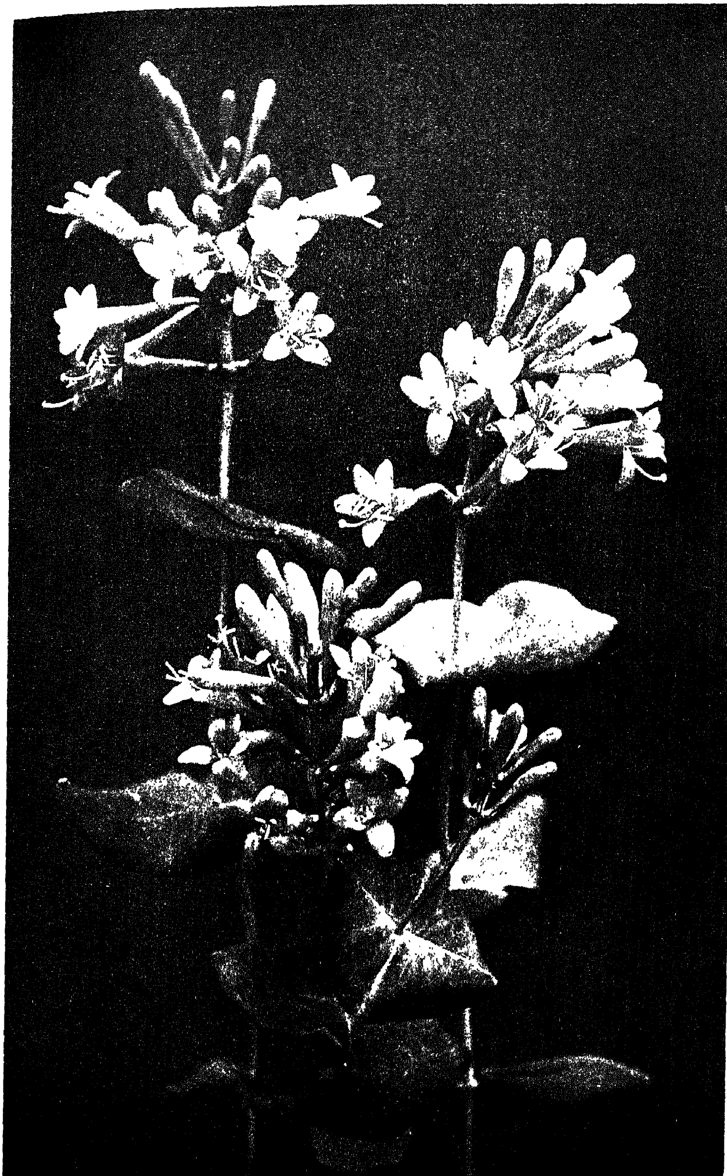
L. serotinum, reddish flowers, late in summer and autumn.

L. caprifolium, goats are said to have a predilection for its leaves—prolific in the south of France.

L. fragrantissima, bears white fragrant flowers about February.

L. brachypoda, yellow flowers, blooming from May to October. Known as Chinese honeysuckle.

[1] Book XXX, chap. 33.
[2] "Fragrant Flowers and Leaves" (1895), 71.



[*R. A. Malby*.

FIG. 36.—Honeysuckle.

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L. sempervirens is a cultivated ornamental climber called trumpet honeysuckle.

L. gigantea or *L. santi* is the most common highly odorous variety found growing on the Riviera. The flowers are at first white and ultimately turn a deep yellow.

There are two other "honeysuckles" which should not be confused with the above, namely :—

Hedysarum coronarium, known as the French honeysuckle and largely grown on the Continent for feeding stock. It belongs to the N.O. Leguminosæ.

Banksia australis is an Australian species of the N.O. Proteaceæ, and named honeysuckle on account of the unusual amount of sweet liquid, like honey, contained in the flowers, which are sucked by the natives. It is stated to be so abundant in *B. ericifolia* and *B. Cunninghamii* that when in flower the ground underneath large cultivated plants is in a complete state of puddle.

Odour.—The perfume of the woodbine is delightfully sweet, and one writer goes so far as to say that the fragrance of the violet does not compare favourably with it. Poets have always shown a preference for it, and in the lines of Mott we read :—

> By rustic seat or garden bower
> There's not a leaf or shrub or flower
> Blossoms on bush so sweet as thee,
> Lowly, but fragrant honey tree.

The honeysuckle fragrance is particularly heavy towards evening and recalls tuberose, jasmin, and orange blossom in perfect blend. This odour has a great attraction for nocturnal moths and crepuscular insects, and incidentally is the means of assuring their fecundation. The nectaria are placed at the base of the tubular corolla and cannot be reached by bees and diurnal butterflies who have a short proboscis. In consequence, their nectar is chiefly reserved for the sphinxes, particularly the *Sphinx ligustri*, the trunk of which is 4 to 5 cm. in length.

Natural Perfume.—This is not yet an important commercial product, although the plant is specially cultivated for the production and utilisation of the flower in the south of France where a small quantity of concrete is prepared. In the Grasse district the blossoms appear during May and June and were experimented with in 1926.[1] The price paid was round about six francs per kilo. More recently the well-known firm of Antoine Chiris[2] treated the flowers of *Lonicera gigantea*, gathered about the middle of June, with petroleum ether. They yielded 3·3 per cent of a dark green, brittle, concrete essence, having an odour less fragrant than the flower. This concrete gave 23·8 per cent of an olive-green absolute, having a syrupy consistency, by the usual method. Steam distillation of this absolute resulted in 9 per cent of essential oil (0·7 per cent from the flowers). This was a limpid yellowish liquid having a penetrating odour, unpleasant at first and later becoming more fragrant but lacking the sweet character of the flowers. On examination it contained neither aldehydes, ketones nor nitrogen.

In the course of a visit to Grasse in 1939, the author discussed the problem of honeysuckle with Mr. Hubert Schleinger of Bertrand Freres, who very kindly undertook to further investigate this question. He purchased 205 kilos of flowers at 5 francs a kilo and treated them with petroleum ether by the volatile solvent extraction process, obtaining 590 grammes of concrete which yielded 320 grammes of absolute flower oil. This had a pleasant odour incompletely reminiscent of the natural flower.

Compounding Notes.—The base of artificial honeysuckle perfumes is composed of linalol, geraniol, or rhodinol, with moderate additions of hydroxy-citronellal and cinnamyl acetate or heliotropin. A substance having a remarkable odour reminiscent of honeysuckle is the dimethylacetal of amyl cinnamic aldehyde. The floral note is obtained with jasmin, narcissus, or tuberose absolutes, and the usual fixing agents are vanillin combined with either styrax or mastic. Modification can be made by substituting methyl anthranilate and benzyl acetate for jasmin or para-cresyl

[1] "Les Parfums de France" (1926), 214.
[2] G. Igolen, "Les Parfums de France" (1937), 298.

phenylacetate for narcissus, and a fixator of no mean order for this perfume is to be found in olibanum.

Synthetic Components:—

Bases.—Linalol, geraniol, rhodinol, amyl cinnamic aldehyde dimethylacetal.

Blenders. — Ylang-ylang Manila, cinnamyl acetate, hydroxy-citronellal, phenylethyl alcohol, terpineol, bergamot, phenylacetic acid, tuberic alcohol, gaiol phenylacetate, decyl formate, heliotropin.

Modifiers.—Nerol, methyl naphthyl ketone, methyl anthranilate, ionone, benzyl amyl oxide, phenyl-cresyl oxide, *p*-cresyl phenylacetate, salicylaldehyde, methyl octine carbonate, geranyl butyrate.

Fixers.—Tolu, olibanum, mastic, vanillin, coumarin, musk ketone, styrax.

Florales.—Rose, jasmin, tuberose, orange blossom, mimosa, reseda, violet leaves.

Aldehydes.—Phenyl propyl aldehyde, C_{10}, C_{11}.

Two formulæ are appended:—

Honeysuckle, No. 1046.

400	Linalol.
200	Geraniol.
30	Cinnamyl acetate.
40	Ylang-ylang oil—Manila.
20	Tolu R.
10	Olibanum R.
1	Phenyl propyl aldehyde.
50	Hydroxy-citronellal.
40	Rose oil virgin.
50	Neroli oil.
10	Ionone alpha.
20	Jasmin absolute.
20	Tuberose ,,
10	Para-cresyl phenylacetate.
50	Terpineol.
9	Vanillin.
20	Musk ketone.
20	Heliotropin.
1000	

Woodbine, No. 1047.

120	Amyl cinnamic aldehyde dimethylacetal.
200	Phenoxyethyl iso-butyrate.
120	Terpineol.
120	Hydroxy-citronellal.
140	Heliotropin.
50	Alpha ionone.
50	Benzyl cinnamate.
60	Styrax resinoid.
4	Violet leaves absolute.
100	Phenylethyl alcohol.
5	Duodecylic ,,
10	Orange blossom absolute.
20	Musk ketone.
1	Undecyl aldehyde.
1000	

Alcoholic Perfumes are not often required, but the following will demonstrate the lines on which to proceed :—

No. 1048.

80	Artificial woodbine, No. 1047.
5	Rose absolute.
4	Jasmin ,,
1	Honey compound.
10	Musk extract, 3 per cent.
900	Alcohol.
1000	

HYACINTH.

History.—The hyacinth, *Hyacinthus orientalis*, belongs to the N.O. Liliaceæ, and is a native of Syria and other parts of Western Asia. It is believed to be the plant so frequently referred to in ancient classical literature. Homer describes it as a fragrant, bell-shaped flower, and says it took the foremost place on the mass of fragrant blossoms that formed the couch of Jupiter and Juno. From what Pliny says in Book XXI, chaps. 39 and 97, and in Book XXV, chap. 80, it is fairly clear that under the name of hyacinth he has confused the characteristics of two different plants. The hyacinth, too, of Dioscorides, Book III, chap. 5,

[*A. Chiris.*

FIG. 37.—Hyacinths.

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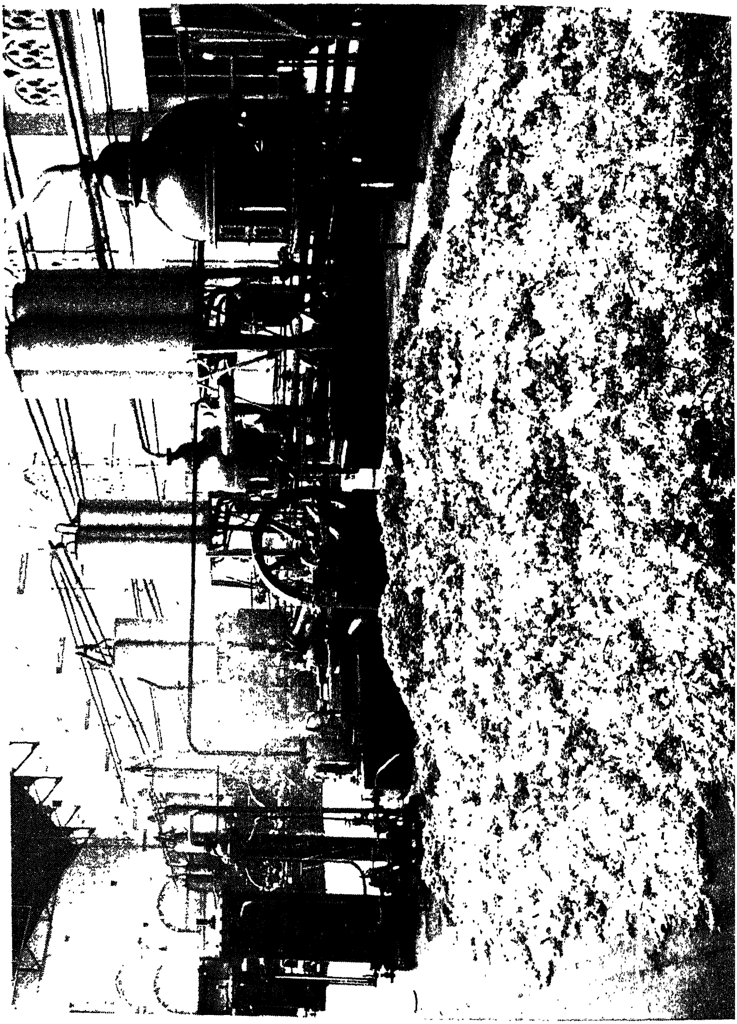


is a different plant being, probably, *Hyacinthus comosus.* The Greek virgins all wore crowns of hyacinths when assisting at the weddings of their friends, and Ovid (Book X) attributes its origin to Hyacinthus, a beautiful Spartan youth, son of Amyclas, King of Amyclæ, who was beloved by Apollo, and accidentally killed by the god in a game of quoits. From his blood a flower sprang up whose petals bore the marks of Apollo's grief. An annual solemnity, called Hyacinthia, was established in Laconia in honour of Hyacinthus. It lasted three days, during which the people, to show their grief for the loss of their beloved prince, ate no bread but fed upon sweetmeats, and abstained from adorning their hair with garlands as on ordinary occasions. The following day was spent in feasting, hence, perhaps, the floral meaning "Play" often attributed to this flower. The poets of the Orient are fond of using the hyacinth for purposes of simile; Hafiz, for instance, compares his mistress's hair with the flower. Hyacinth locks are expressive of graceful tresses, because the petals of the flower turn up at the points.

The hyacinth was introduced to Britain during the sixteenth century, and was at that time a single-flowered species, but during the seventeenth century double-flowered ones began to appear. Four varieties were then recognised, the single and double blue, the purple and the violet. It is extensively cultivated in Holland, particularly at Haarlem, where there are large areas devoted entirely to the growth of this and other bulbous plants. According to one well-known firm there are now over 10,000 acres under cultivation by the Dutch. The explanation of this extraordinary development in horticulture appears to be due to the peculiar adaptability of the soil and climate of Holland. When these huge areas are covered with blooms they present a wonderful sight, and the atmosphere for miles around becomes impregnated with their exotic fragrance.

Varieties.—The genus *Hyacinthus* comprises about thirty species, the varieties of which through cultivation have become numerous. At least 4000 varieties have been reported, but commercially not more than 5 per cent are exploited. *H. orientalis* is the principal cultivated species, while *H. non-scriptus*, the blue-bell, and *Muscari racemosum*, the grape-hyacinth, are often found growing wild in this country. On the shores of the Mediterranean and in the Pyrenees, there is a small flowering species, *H. amethystinus*, having pretty bright blue flowers.

In the south of France the wild blue hyacinth is extracted by the Grasse works. Some manufacturers in Holland have taken up the production of absolute, and, as they say, it is worthy of much wider favour.

Odour.—The odour of hyacinths is heavy but has been described as ethereal. This probably may be accounted for by the fact that the early flowering plants have a finer odour than the later flowering kinds, and also that just when the blossoms appear the perfume is much more delicate. If a plant is placed in a room or any confined space the odour becomes overpowering.

Natural Perfume.—This is extracted on a small scale by means of volatile solvents, and both the wild and cultivated flowers are used. The lighter coloured varieties yield the finest perfume and, commercially, the single blossoms are found to give the best results. Very small quantities are available, since growers have found it more remunerative to sell the flowers for decorative purposes or, as in most cases, to sell the bulbs. The production of the natural perfume, however, is now a greater commercial success, and, according to Fölsch,[1] 150,000 kilograms of flowers were worked up for perfume during 1928. About 6000 kilos of flowers yield 1 kilo of absolute flower oil.

Chemistry.—The chemistry of the hyacinth perfumer is not yet completely understood. Some years ago, however, an essential oil was isolated by a process similar to that for the preparation of *absolutes*, the yield being 0·016

[1] "Riechstoffindustrie," 4 (1929), 123.

per cent. It had a disagreeable and pungent odour, and only resembled the true odour of the flower after great dilution. The following bodies were identified as constituents :—[1]

Benzyl benzoate.
Benzyl alcohol.
Esters of cinnamic alcohol.
Hydrogen sulphide.
A body with a distinct odour of vanillin.

More recently L. Hoejenbos and A. Coppens[2] extracted the flowers of *H. orientalis*, L., grown in the region of Amersfoort, Holland. They used benzene as the solvent and obtained a light brown product containing paraffins and waxes. These were separated by freezing an alcoholic solution and the odour-bearing constituents were isolated by steam distillation of the residue. The following constituents were identified :—

Benzyl alcohol.
Phenylethyl alcohol.
Cinnamic alcohol.
Cinnamic aldehyde.
Benzaldehyde.
Methyl *o*-methoxy benzoate.
Ethyl *o*-methoxy benzoate.
Cinnamyl acetate.
Dimethyl hydroquinone.
Eugenol.
Methyl eugenol.
Benzyl acetate.
Benzyl benzoate.
Methyl-methyl anthranilate.
Benzoic acid.

N-Heptanol and œnanthol were also probably present. Phenyl acetaldehyde and homologues, aliphatic aldehydes, alcohols and esters were not found.

Compounding Notes.—The reproduction of the hyacinth odour is one of the easiest in synthetic perfumery, as there are several definite chemical bodies whose odour, particularly on dilution, has a marked resemblance to that of the flower. The most important of these is phenylacetic aldehyde, a liquid of syrupy consistency which has a

[1] Spalteholz and Enklaar, "Chem. Weekblad," 7 (1910), 1, through "Year Book of Pharmacy" (1910), 82.
[2] "American Perfumer" (June, 1932), 210.

tendency to polymerise and become exceedingly viscous, occasionally throwing down an unsightly deposit. It is known as *Hyacinthin*, and 4 to 5 grams dissolved in a litre of alcohol will produce the equivalent of a first pomade washing. Its odour is approximated to by *a*-bromstyrole, but this material has a rather harsh odour and is not used in fine perfumery. It finds employment, however, in the soap industry. Other bodies having an odour recalling hyacinths are, cinnamic alcohol, styrolene acetate, and (to a less extent) phenyl propyl alcohol. The proportion of the first-mentioned body in synthetic hyacinth oils rarely exceeds 40 per cent, and this can be much reduced when cinnamic alcohol is used in addition. The blenders and modifiers include such bodies as terpineol, benzyl alcohol, benzyl acetate, ionone, bergamot, heliotropin and phenylethyl alcohol.

Floral approximation is obtained with hyacinth, neroli, rose, jasmin, and violet leaves (traces). The best fixatives are galbanum and styrax.

Synthetic Components :—

Bases.—Phenylacetic aldehyde, cinnamic alcohol, bromstyrole, styrolene acetate, phenyl propyl alcohol, hydratropa aldehyde.

Blenders.—Bois de rose, bergamot, terpineol, phenylethyl alcohol, benzyl alcohol, benzyl acetate, hydroxy-citronellal, petitgrain French, phenylacetaldehyde dimethylacetal, benzyl propionate, heliotropin.

Modifiers. — α-Ionone, benzaldehyde, ylang, almond, cinnamon, clove, methyl anthranilate, cinnamyl acetate, cuminic aldehyde, benzyl phenylacetate, phenylethyl isobutyrate, methoxy acetophenone, iso-eugenol.

Fixers.—Civet, vanillin, musk ambrette, vanilla, benzoin, styrax, galbanum.

Florales. — Hyacinth, neroli, rose, jasmin, tuberose, orange blossom, violet leaves (traces only).

Aldehydes.—Phenyl propyl aldehyde, C_{10}, C_8.

Two formulæ follow :—

Hyacinth, No. 1049.

150	Phenylacetic aldehyde.
300	Cinnamic alcohol.
100	Linalol.
50	Benzyl acetate.
50	Phenylethyl alcohol.
1	Violet leaf absolute.
20	Hyacinth ,,
90	Petitgrain—French.
70	Terpineol.
10	Galbanum R.
20	Rose otto.
20	Jasmin absolute.
100	Heliotropin.
9	Iso-eugenol.
10	Musk ambrette.
1000	

Jacinthe, No. 1050.

200	Hyacinthin.
150	Styrone.
150	Terpineol.
50	Petitgrain oil, terpeneless
70	Bergamot oil.
30	Hydroxy-citronellal.
40	Phenyl propyl alcohol.
20	α-Ionone.
50	Benzoin R.
10	Tuberose absolute.
20	Rose ,,
50	Benzyl acetate.
100	Heliotropin.
20	Coumarin.
40	Styrax.
1000	

Alcoholic Perfumes are generally compounded from phenylacetic aldehyde and terpineol backed up with flower absolutes of similar odour type. They can also be made by utilising either of the foregoing oils. Examples follow:—

No. 1051.

70	Hyacinth, No. 1049.
15	Ambrone, No. 1007.
5	Tuberose absolute.
10	Hyacinth ,,
900	Alcohol.
1000	

No. 1052.

20	Phenylacetic aldehyde.
20	Terpineol.
10	Orange blossom absolute.
3	Tuberose absolute
10	Jasmin ,,
5	Rose ,,
30	Civet extract, 3 per cent.
2	Galbanum R.
900	Alcohol.
1000	

JASMIN.

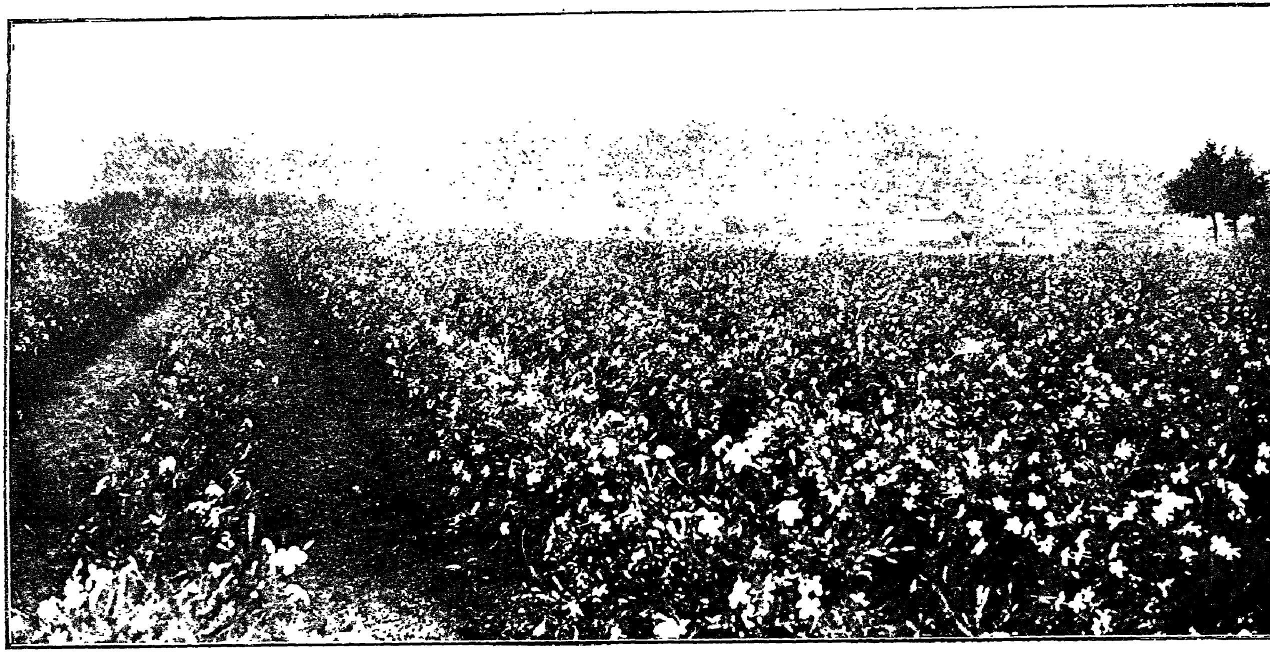
History does not appear to contain any definite references to the jasmin flower until about the sixteenth century. It belongs to the N.O. Oleaceæ, and is supposed to be a native of India and to have become indigenous to Southern Europe at an early date. Dioscorides tells us that the Persians obtained an oil from a white flower with which they perfumed their apartments during the repasts, and it is possible that this may have been the jasmin. The Hindus have always used perfumed flowers in the performance of their religious rites, and they also are stated to have had a particular preference for this flower. The origin of the introduction of jasmin into Italy has given rise to a legend recorded by Donald McDonald,[1] which relates that a certain Duke of Tuscany was the first possessor of the plant, and as he wished to retain it as a novelty,

[1] "Fragrant Flowers and Leaves" (1895), 59.

[A. Chiris.

FIG. 39.—Jasmin Flowers.

[To face page 140.



[*A. Chiris.*

Fig. 40.—Plantations of Jasmin at Grasse.

[*To face page* 141.

forbade his gardener to give away a single sprig of it. The latter gentleman, however, seems to have neglected his instructions, and being an ardent lover, presented his lady with a bunch of the prohibited blossoms on her birthday. She was so charmed with the perfume of the flowers that she planted them in the ground, and by careful cultivation was able to produce large quantities of the blossoms, which she sold, and, after amassing a fortune, married the happy gardener. To-day jasmin is so common that it is difficult to find many gardens in Europe that are not graced by its presence.

Varieties.—The species most commonly known in Britain is *Jasminum officinale*, and its varieties have golden and silver-edged leaves, while some are double-flowered. It is a native of the warmer parts of Asia and became naturalised in the south of Europe at an early date. The blossoms appear from June to October, and while their perfume is sweet, its power does not approach that of the same species grown in warmer climates. *J. grandiflorum* is often grafted on to cuttings of this species.

J. sambac is a native of Arabia, but is found growing wild in India. It is a climber, with single and double white flowers which emit a most delightful fragrance. *J. trifoliatum* is a variety of this species known in India as *Kuddamulla* and in this country as the "Tuscan" jasmin. It seems possible that this may be the variety referred to in the legend related above. The Indian ladies are said to hold the flowers of this jasmin species in great esteem and make them into necklaces. The blossoms are used for perfuming tea in China.

J. odoratissimum is a native of Madeira, with yellow flowers, which retain their perfume when dry. This species, known as "Shuei flowers," is cultivated in Formosa where the blossoms are used for perfuming tea. They have been treated with volatile solvents by Tsuchihashi and Tasaki[1] who obtained 0·277 per cent of concrete oil,

[1] "Report" of Schimmel & Co. (1919), 33.

which upon maceration with alcohol yielded 0·116 per cent of volatile oil and 0·166 of floral wax. The oil was a reddish-brown liquid and contained the following constituents :—

Linalol	6	per cent.
Linalyl acetate	6	„
Benzyl alcohol	1·6	„
Benzyl acetate	6	„
Indole, Methyl anthranilate	10	„
Diterpene or sesquiterpene alcohol	57	„
Jasmone	nil.	

The flowers gave no result with enfleurage.

J. azonicum has white flowers, and is also a native of Madeira. It is sometimes grown in England.

J. paniculatum is a native of China, and has white flowers, which are used for scenting tea.

J. hirsutum has white flowers of exceptional fragrance, and is also a native of China and possibly India.

J. nudiflorum and *J. revolutum* are Chinese varieties with yellow perfumed flowers. According to Meunissier[1] the latter is found on the slopes of the higher mountains of Nepal. It is much cultivated in India for the manufacture of perfume, as is also *J. auriculatum*.

J. gracillimum has white flowers.

J. grandiflorum is a native of the East Indies, and occurs in both double and single form. It is known as the Spanish or Catalonian jasmin, and its flowers retain their perfume when dried. The plant resembles *J. officinale*, upon which it is generally grafted in the south of France.[2]

J. gardeniodorum is indigenous to Togoland, where it flowers almost all the year round. It is a twining shrub

[1] "La Parfumerie Moderne," 18 (1925), 97.

[2] *J. grandiflorum* is also grown in Tunis. The cuttings are placed about 2 feet apart and the blossoms collected for the preparation of perfume. In a well-kept plantation 1000 plants yield about 40 kilos of flowers.

having highly odorous white flowers, the perfume reminding of gardenias rather than of jasmin.

J. primulinum and *J. polyanthum* are two species recently found growing in Yunnan. They have large white (rose tinted on the edges) blossoms and are highly odoriferous.

J. Stephanense is a hybrid recently obtained by Javit by crossing *J. officinale var. grandiflorum* with *J. Beesianum.* The plant is interesting on account of its having rose-coloured petals.

Odour.—The odour of jasmin, like that of rose, is unique, and represents a type that cannot be *exactly* imitated at present by a mixture of any known synthetic aromatic chemicals or natural isolates. The discovery of the chemical structure of the jasmin ketone by two well-known makers of synthetics has brought the approximation of the natural odour by synthesis a step nearer. If the recent fluctuations in price of flowers continues, perfumers will be compelled to resort more and more to synthetic substitutes and in consequence a falling off in the demand for the natural product may be anticipated. Many perfumes owe their fragrance to the skilful use of the jasmin odour, and it undoubtedly rivals that of rose for the premier position in a long list of aromatics.

Natural Perfume.—In the south of France the natural perfume is obtained from *Jasminum grandiflorum* which has been grafted on *J. officinale.* The flowers are white and highly odoriferous. Another species, *J. fruticans*, which has yellow flowers, has been experimentally grafted on this latter species. The resulting blossoms were white and extremely aromatic but the plantations thus grown died off very rapidly. The flowers are grown around Grasse in the following communes, and in a normal year yield the weight of blossoms appended :—

Grasse—Montauraux . . .	450,000 kilos.
Mouans—Mongins . . .	200,000 ,,
Pegomas—Cannes . . .	100,000 ,,

The selection of ground for the cultivation of jasmin is very important. Water is necessary for its irrigation during the summer months and it must have a sunny aspect to avoid the frosts in winter. On the other hand, if the soil is too damp the plant dies, while if it is too warm the plant grows too quickly in the springtime. This likewise injures its growth. According to a French periodical[1] the ideal soil for plantation is that which has been sown with cereals for many years or has been grown to forage crops. Ground that has been planted with trees is used when necessary, but this is not without danger. If any roots are left in the ground and they decay, a disease develops, probably of a fungoid nature, which in Provence is called "la mouffe." This rapidly exterminates the jasmin. The most dangerous trees are fig, mulberry, and olive.

The ground is dug over deeply and then one of two methods of planting employed: either to plant directly or to transplant rooted plants. The latter is better, because more regular plantations result. The grafting is done a year later and some flowers are obtained after the first year. Some growers claim to have successfully grafted after six months. After blooming the jasmin is pruned and the ground covered to prevent freezing. In the following spring, when all fear of frost is over, the ground is uncovered and the plant shoots up. The blossoms appear generally about the middle of July and are collected up to the middle of October; in an exceptionally good year, collection may go on until the middle of November. The flowers gathered during August and September yield the largest quantity of perfume. They are picked off the stem as soon as possible after they open, which usually occurs in the evening up to the middle of August, and in the early morning after that date. The shortage of labour since the Great War has made it difficult to adhere to these times. One hectare of jasmin, planted with 100 thousand cuttings, yields after grafting several hundred kilos of blossoms in

[1] "Revue des Marques" (Aug. 1924).

the first year, and this rises to 4000 kilos in the fourth year. This yield is maintained until about the tenth year, after which it decreases. The cultivators of jasmin sometimes experience considerable losses through the attacks of caterpillars, which not only eat the leaves but attack the corollas about midway, with the result that the flower rapidly withers. The flowers after collection are immediately conveyed to the works, where their aromatic constituents are extracted by enfleurage or by means of volatile solvents.

The comparative value of these two processes in relation to this flower has led to much discussion and has already been referred to in the chapter on the production of flower perfumes. While Niviere does not consider there is any marked difference in the yield of *Essential Oil*, having regard to all the facts, von Soden has more recently determined the quantity of volatile oil obtained from the extraction of several thousand kilos of flowers, and he places the relative yield as between enfleurage and volatile solvents as 5 to 2. This chemist considers the latter process preferable because it recovers precisely those very important and as yet unknown odorous compounds which, owing to their lower degree of volatility, remain behind in the enfleuraged waste flowers with the enfleurage process, and are with difficulty absorbed into the fat. Flowers which remain lying in the chassis for 24 or 48 hours undergo radical changes while fading ; new compounds arise in them and affect the recovery of odorous substances originally present in them which were left behind.[1] E. S. Guenther[2] has made a number of experiments on these comparative processes, and whereas 700 kilos of jasmin flowers yielded 1 kilo of absolute by volatile solvents, only 225 kilos were necessary to produce the same weight of absolute by enfleurage. By steam distillation of the absolutes, the relative yield of volatile oil was $2\frac{1}{2}$ or 3 to 1 in favour of enfleurage.

[1] "Deutsche Perf. Ztg.," 11 (1925), 149.
[2] "American Perfumer" (Oct. 1934), 397.

At Avola in Sicily considerable quantities of jasmin are grown on the flower farms of Antoine Chiris, whose product is much appreciated at its competitive price. During the author's visit to Italy in 1938, he had the opportunity to visit the Government's experimental station at Brancaleone, opened in 1930. Sixty hectares of jasmin were under cultivation, the area being increased in the following year to 100 hectares. The concrete was extracted at a factory on the spot, and most of it was purchased by Grasse firms. Production costs here are lower than at Grasse because, since the winters are less severe, the plant is allowed to "run riot" and receives no attention as in the south of France. The Italian plants are merely pruned early in the year and the ground then weeded and turned over. Production in 1938 was 250 kilos of concrete, equivalent to approximately 100 kilos of absolute.

In India jasmin flowers are extracted by a peculiar method of "enfleurage." Sesame seeds are washed, the husks removed and then dried. These are placed in layers alternating with jasmin blossoms and left thus for a period of 12 to 24 hours. Fresh flowers replace the exhausted ones until the "pomade" becomes saturated. The oil is then expressed from the seeds and is known as "sire ki tilli."

In Northern Africa the development of jasmin plantations is being experimented with by some of the Grasse houses. There seems to be no reason why their efforts should not ultimately prove successful. The plentiful supply of cheap labour there should be an important factor in price stabilisation.

Chemistry.—There is some difference of opinion as to the constitution of the jasmin perfume, but it is generally recognised that the analysis made by Hesse and Muller[1] in 1899 represents its probable composition. A liquid otto of jasmin was obtained from

[1] "Berichte" through "Year Book of Pharmacy" (1901), 74.

pomade by steam distillation, and this was found t contain—

Benzyl acetate	65	per cent.
Linalol	15·5	,, ,,
Linalyl acetate	7·5	,, ,,
Benzyl alcohol	6	,, ,,
Other bodies	5·5	,, ,,

The composition of the unidentified constituents wa investigated later by Hesse, and among those bodies founc were the following :—

Indole	2·5	per cent.
Jasmone	3	,, ,,
Methyl anthranilate	0·5	,, ,,

Other bodies identified include *p*-cresol and geraniol.

Hesse only obtained with certainty indole in the oi obtained by enfleurage, and he concluded that it did not exist in the living flower, but only in a complex form not revealed in the extracted or distilled oils. Thus indole, according to Hesse, was formed during enfleurage. This view has been rejected by von Soden and P. Baccarini, the former having found it in the oil obtained by volatile solvents and the latter (micro-chemically) in some species of jasmin. The question has recently been further investigated by Cerighelli[1] whose experiments have resulted in the following conclusions :—

1. Indole is a normal constituent of *Jasminum grandiflorum*. In the flower it may exist as a complex combination not detected in the floral bud. When the flower opens the indole is liberated and is dissipated in the atmosphere. During the night indole accumulates in the tissues of the flower to be dissipated as the light acts on the plant.

2. Indole continues to be liberated by the gathered flowers ; it only accumulates in a confined atmosphere.

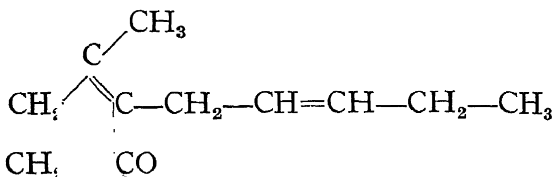
3. Treated after keeping in a confined atmosphere (as is the case in industry), the flowers give up indole to the process of extraction and distillation.

[1] "P. and E.O.R." (1925), 13.

4. Treated by enfleurage the flowers yield (over a period of 24 hours) 3 or 4 times more indole than by either extraction or distillation.

A further constituent, farnesol, has been identified by F. Elze.[1] More recently the presence of up to about 3 per cent of eugenol has been discovered by Mm. Sabetay and Trabaud.[2]

The constitution of jasmone has recently been studied by Treff and Werner[3] in the laboratories of Heine, and they consider it to be a 3-methyl-2-(*n*-penten-2′ yl)—cyclo-penten-2-one-1 having the formula :—



Similar discoveries were made by L. Ruzicka and M. Pfeiffer in the laboratories of Naef as far back as 1927 but were deposited with the Swiss Chemical Society and not published until 1933.

All the above-mentioned bodies are prepared synthetically, but a new body called *Jasmophore* has been introduced by the well-known firm of Naef, and, when used in combination with jasmin absolute chassis, is capable of improving most jasmin perfumes.

Compounding Notes.—The basic constituent of all synthetic jasmin oils is benzyl acetate, whose odour bears a distinct resemblance to that of the flower. It is used up to about 40 per cent, but this quantity can be reduced if benzyl formate is also employed. The latter body has a much harsher note, and its use is not recommended. If desired, the aroma of either ester can be much improved

[1] "Chem. Ztg.," 50 (1926), 782.
[2] "P. and E.O.R." (1939), 183.
[3] Berichte, 66 (Oct. 11, 1933), 1521.

and *softened* by the addition of small quantities of meta-cresol phenylacetate—the mixture being allowed to mature a month before use. Benzyl alcohol, benzyl propionate, and phenylethyl alcohol are useful, while linalol is an indispensable constituent. Methyl anthranilate enters the composition of most synthetic jasmins, but much better results are obtained with terpeneless French petitgrain oil. Indole used to be considered a necessary constituent, but 1 per cent should not be exceeded. The objection to the use of this body is that it produces a deep red colour on standing, and especially on exposure to light, which precludes the employment of oils containing it in such cosmetics as white skin creams, etc. One of the most remarkable discoveries of recent years is the synthesis of amyl cinnamic aldehyde, a substance, while having no relation to indole, yet completely replaces it in the synthesis of all jasmin compounds. It is a greenish-yellow liquid which on extreme dilution has an odour in no way dissimilar to that of the flower. Its use makes the production of *colourless* jasmins a comparatively easy matter. Amyl cinnamic aldehyde, when first added to a jasmin compound, does not completely develop its fragrance; it really requires about a month to thoroughly blend. In consequence a careful hand is necessary when using it, and 3 or 4 per cent should not be exceeded. It is a remarkable fixative. This synthetic does not, however, pretend to dispense with the use of natural jasmin which is always found in the finest imitations. The comparative values of the absolutes by enfleurage and petroleum ether have been discussed at length by the author in two well-known papers,[1] when it was found that having regard to both odour and colour, there was, price for price, a very slight preference for the former. Jasmin chassis is, however, worthy of careful note because the indoloid character of its odour makes its use in compounds particularly advantageous in covering the roughness of odour of most synthetics. The price of the finished compound will of

[1] "Chemist and Druggist" (1928), 308, and "American Perfumer" (1928), 69.

course depend upon the percentage of natural absolute employed, and even 1 per cent makes a noticeable difference to the perfume without appreciably increasing the cost. The floral note may be improved by adding neroli oil and tuberose or orange blossom absolute. Phenylethyl iso-butyrate, methyl ionone, decylic aldehyde, octyl acetate, hydroxy-citronellal (fairly large percentages) and cinnamyl acetate are often used as ingredients of this perfume. The range of synthetics for the preparation of artificial jasmins has been widened by the inclusion of the following substances, which are covered by a recent German patent :—

Benzyl acetone.
Phenyl ethyl-dimethyl-carbinol.
Phenyl ethyl-methyl-ethyl-carbinol.
Benzyl isopropyl alcohol.

Phenyl ethyl-dimethyl-carbinyl acetate is said to be a very valuable component for exceptionally fine floral oils.

Synthetic jasmone referred to above is really most indispensable in the reproduction of the jasmin pomade type of odour. It is admittedly difficult to use, but 25 per cent with jasmin chassis gives extraordinarily flowery results.

The fruity note of jasmin may be obtained with undecalactone or ethyl-methyl-phenyl glyciate.

Synthetic Components :—

Bases.—Benzyl acetate, linalol, phenylethyl alcohol, amyl cinnamic aldehyde, hydroxy-citronellal, synthetic jasmone, benzyl acetyl acetate.

Blenders.—Methyl anthranilate, terpineol, sweet orange, benzyl formate, benzyl alcohol, cinnamic alcohol, nerol, octyl acetate, cinnamyl acetate, petitgrain French, and benzyl propionate, benzyl chloracetate, benzyl acetone, jasmophore, decahydro betanaphthyl acetate (soaps), linalyl acetate, phenylacetic aldehyde.

Modifiers.—Ylang-ylang Bourbon, benzyl butyrate, methyl salicylate, *p*-cresyl phenylacetate, *m*-cresyl phenylacetate, phenylethyl iso-butyrate, ionones, anisic aldehyde, cyclohexanyl butyrate, celery, heliotropin.

Fixers.—Civet, tolu, indole, styrax, musk ketone.
Florales.—Jasmin, neroli, tuberose, orange blossom.
Aldehydes.—C_8, C_{10}, phenyl propyl aldehyde, C_{14} . C_{16}.

The following formulæ will give an idea of how these numerous bodies may be employed, and the quantities can be varied to suit individual requirements :—

Jasmin Extra, No. 1053.

200	Benzyl acetate.
100	Linalol.
250	Hydroxy-citronellal.
100	Phenylethyl alcohol.
90	Phenylethyl iso-butyrate.
50	Alpha ionone.
30	Amyl cinnamic aldehyde.
20	Ylang oil—Manila.
10	Phenylacetic aldehyde.
50	Benzyl salicylate.
3	Decylaldehyde, 10 per cent
1	Indole.
1	Octyl iso-butyrate.
30	Para-cresyl phenylacetate.
20	Musk ketone.
10	Jasmone synthetic.
30	Jasmin absolute.
5	Civet ,,
1000	

Jasmin, No. 1054.

350	Benzyl acetate.
30	Benzyl formate.
150	Linalol.
100	Benzyl alcohol.
50	Methyl anthranilate.
150	Hydroxy-citronellal.
30	Ylang-ylang oil—Manila.
50	Amyl cinnamic aldehyde.
10	Neroli oil.
10	Aldehyde C_{10}, 10 per cent.
70	Jasmin absolute, chassis.
1000	

Jasmin—Colourless, No. 1055.

300	Benzyl acetate extra.
50	Benzyl alcohol.
50	Linalol.
10	Linalyl cinnamate.
100	Linalyl acetate.
30	Phenyl ethyl alcohol.
100	Methyl ionone.
25	Ylang absolute.
5	Undecalactone.
30	Amyl cinnamic aldehyde.
200	Hydroxy-citronellal.
100	Jasmone synthetic.
1000	

Alcoholic Perfumes may be prepared as follows :—

No. 1056.

80	Jasmin extra, No. 1053.
10	Jasmin absolute.
5	Tuberose „
5	Orange blossom absolute.
900	Alcohol.
1000	

No. 1057.

60	Jasmin—colourless No. 1055.
10	Muguet No. 1063.
5	Ylang-ylang absolute.
1	Orange oil, terpeneless.
2	Heliotrope No. 1042.
10	Jasmin absolute.
5	Orange blossom absolute.
2	Rose absolute.
4	Musk ketone.
1	Civettone, 10 per cent.
900	Alcohol.
1000	

LILAC.

The Plant.—There are three well-known species[1] of lilac, *Syringa vulgaris*, the common lilac; *S. Chinensis*, the Chinese lilac; and *S. Persica*, the Persian lilac. They belong to the N.O. Oleaceæ, and are natives of the East. The common lilac is a bushy, erect shrub, native of Persia,[2] and was introduced into this country by way of Turkey and Spain about 350 years ago. It has become one of our most common ornamental shrubs, of which there are several varieties, whose inflorescences may be red, purple, blue, or white. Of the *white* varieties the most popular are, Marie Legrange, Alba grandiflora, Alba magna, and Alba virginalis, while of the coloured varieties, souvenir de L. spath, stands supreme with its massive clusters of large blossoms.

The Chinese or Rouen lilac comes between *S. vulgaris* and *S. Persica*, and is also known as *S. dubia* and *S. rothomagensis*. The Persian lilac is distinct from the above two species as it is smaller and more erect.[3] It was introduced into Western Europe nearly 300 years ago. The branches are slender and spreading, and the flowers are deliciously fragrant. They take the form of small clusters, which are of a pale lilac colour, or nearly white. A pretty variety with deeply cut leaves, *S. luciniata*, is much esteemed.

During recent years several double forms have been introduced and are now much cultivated. The principal species are *S. Hyacinthiflora plena*, *S. Lemoinei*, and *S. Ranunculiflora*. The flower clusters are much denser and generally last longer than the single varieties.

There is a remarkable sequence of flowering in the lilac.

[1] According to S. D. McKelvey (1928), there are in all 28 species known to science.

[2] According to H. S. Redgrove ("The Manufacturing Chemist," 1930, 11), it is native to the Balkans, brought to Vienna by way of Constantinople prior to 1565, and thence to England in 1629.

[3] This is a misnomer according to Redgrove (*ibid.*), who gives the native location as Kansu in China.

The blossoms appear in France from April 20-30; in Denmark from May 1-15; in the south of Sweden and Russia from June 1-15; in the centre of Russia, Sweden, and Norway after June 16.

Winter Lilac, often seen in the florists during December and January, is one of the coloured forms which has been forced. The principal seat of this industry is around Paris at Fontenay-aux-Roses and Vitry-sur-Seine. Here, according to Eleanor Eales,[1] are large sheds full of dry-looking stems which for about five years have been cultivated in the lilac fields outside. These stems are transported in trolleys along the rails that lead to the forcing chambers. The latter are situated on each side of a central alley, and look much like bathing cabins in public baths.

Each contains 200 lilac plants in a space of 36 × 12 feet. The stems are planted one by one in the soil which covers the ground to a depth of 6 inches, and the roof is glazed and fitted with adjustable blinds.

These forcing chambers are kept at a temperature of 86° F. and curved pipes run along the walls arranged to impart the necessary dampness to the atmosphere.

Two days after their planting, the lilacs have already begun to bud, buds which are immediately suppressed, and only 2 to 4 flower buds are allowed later on to grow at the top of the stem, with probably two leaf-buds lower down for ornament.

The greatest care is taken during the opening of the flowers. Buds and leaves are mercilessly sacrificed, the thermometer is constantly consulted to see that the plant has the right temperature, from time to time the lilacs are sprayed with a vaporiser, and—most important item—as the flower approaches perfection the amount of daylight is increased, no light at all having been permitted till the petals began to open.

At the end of 17 or 18 days the blooms are ready to pick and this cutting generally takes place in the evening.

[1] "Daily Chronicle" (Dec. 12, 1923).

[*R. A. Malby.*

FIG. 41.—Syringa Vulgaris.

[*To face page* 154.

The branches are taken to a cool cellar, and placed in water to preserve them. Finally they are tied in bunches round straw mushrooms and frequently surrounded by wallflower leaves. They are then carefully packed and despatched to the principal capitals of Europe.

Odour.—The perfume of lilac in the form of the natural absolute is not an article of commerce although attempts to extract the flowers were made some time ago by P. Dhumez. The oil obtained was greenish-yellow in colour but its odour was not even reminiscent of the blossoms. It was quite viscous in character but nothing is known of its constituents. More recently G. Igolen[1] has extracted the fresh blossoms of *Syringa vulgaris* in the laboratories of Antoine Chiris. He used petroleum ether which gave 0·24 to 0·36 per cent of a dark green concrete. Benzene yielded 0·6 per cent of a blackish-green brittle concrete rich in waxes. The odour of both concretes was disagreeable. Thirty-eight per cent of absolute was obtained from the former with no improvement in odour. Steam distillation of this product yielded 8·72 per cent of oil, having a greenish-yellow colour and smelling of linseed oil. The presence of indole could not be confirmed.

The smell of lilac differs mainly between the coloured and the white types. The former have a fresher green character whereas the latter are extremely indoloid. They in fact remind very much of indole with the superimposition of hawthorn and jasmin. No white lilac perfume is perfect without indole.

Compounding Notes.—The generally accepted basis of all lilac compounds is terpineol, which on dilution closely resembles the odour of the natural flower. It may be used up to 60 per cent of the total, and is much improved by the addition of hydroxy-citronellal. Another base having a marked lilac odour is to be found in anisic aldehyde made from para-cresol (similar but softer notes are

[1] "Les Parfums de France" (1938), 117.

obtained with anisic alcohol). Good results are obtained by using about 10 per cent. These bases are blended with phenylethyl alcohol, dimethyl benzyl carbinol, benzyl alcohol, French petitgrain, or alpha ionone, and more character is given to the perfume by the use of heliotropin, methyl eugenol, phenylacetic aldehyde, rose, and ylang-ylang oils, in small quantities. A fresh flowery note may be struck by the inclusion of some natural jasmin absolute chassis, and the compound may be fixed by a suitable addition of styrax, musk ketone, cinnamic alcohol, iso-eugenol, or ambergris. The use of indole is also desirable. Very good pseudo-lilacs can be compounded from synthetic muguet, in which case the employment of a little ionone will give satisfactory results. Two new synthetics having lilac odours have recently been prepared by Guerbet.[1] These substances are :—

Methyl benzyl-ethyl alcohol and
Ethyl benzyl-ethyl alcohol.

Synthetic Components :—

Bases.—Terpineol, hydroxy-citronellal, anisic aldehyde, anisic alcohol.

Blenders.—Petitgrain French, phenylethyl alcohol, geraniol, benzyl alcohol, bois de rose, benzyl acetate, amyl cinnamic aldehyde, benzyl salicylate, laurinic alcohol, linalol, dimethyl benzyl carbinol.

Modifiers.—Phenylacetic aldehyde, α-ionone, ylang—Manila, *p*-cresol methyl ether, gamma undecalactone, heliotropin, octyl acetate, amyl salicylate, benzaldehyde, phenyl propyl acetate, acetophenone.

Fixers.—Styrax, musk ambrette, olibanum, musk ketone, cinnamic alcohol, tolu and Peru balsam, benzoin, vanillin, coumarin, indole, iso-eugenol.

Florales.—Neroli, rose, jasmin, tuberose.

[1] "Comptes Rendus," 146, 1405.

Aldehydes.—Phenyl propyl aldehyde, para-iso-butyl alpha methyl hydrocinnamic aldehyde, methyl phenyl acetaldehyde.

Formulæ for these compositions follow :—

Lilac, No. 1058.

200	Terpineol.
200	Hydroxy-citronellal.
10	Phenylacetic aldehyde, 10 per cent.
70	Benzyl acetate.
80	Anisic alcohol.
50	Linalol.
10	Ylang oil—Manila.
30	Jasmin absolute chassis.
10	Phenyl propyl aldehyde.
100	Phenylethyl alcohol.
25	Methyl eugenol.
100	Cinnamic alcohol.
10	Acetophenone.
100	Heliotropin.
5	Indole, 10 per cent.
1000	

Persian Lilac, No. 1059.

600	Muguet, No. 1063.
20	Ionone alpha.
70	Phenyl propyl acetate.
30	Amyl cinnamic aldehyde.
20	Ylang-ylang oil—Manila.
10	Jonquille absolute.
5	Rose „
15	Iso-eugenol.
90	Anisic aldehyde.
30	Methyl phenyl acetaldehyde.
60	Heliotropin.
20	Jasmin absolute.
30	Musk ketone.
1000	

Alcoholic Perfumes are based upon synthetics, and the flowery effect is obtained by the liberal use of flower absolutes :—

No. 1060.

80	Lilac, No. 1058.
5	Muguet, No. 1063.
5	Musk extract, 3 per cent.
2	Tuberose absolute.
8	Jasmin ,,
900	Alcohol, 90 per cent.
1000	

No. 1061.

60	Lilac, No. 1059.
5	Neroli oil.
2	Jonquille absolute.
2	Tuberose ,,
1	Cassie ,,
10	Jasmin ,,
20	Civet extract, 3 per cent.
900	Alcohol, 90 per cent.
1000	

LILY.

History.—Lilies, referred to in a general sense as beautiful white flowers, have been mentioned in literature as far back as 1014 years B.C. In the Scriptures they are spoken of no less than eleven times, sometimes as a direct reference to the flower, as in The Song of Solomon ii. 1 and 2, and occasionally as lily-work, for forming patterns of carved ornaments for the pillars and other parts of Solomon's temple, as in 1 Kings vii. 19. Commentators have not been able to definitely clear up the botanical source of these flowers. John Smith says that *Lilium chalcedonicum* is the only true lily native of Palestine, although the white lily, *L. candidum*, is much cultivated there, but is a doubtful native. Some suppose the first to have been the "Lily of the Valley"[1] while Sprengel considers it to be the jonquille, *Narcissus Jonqulila*; others think it was *Amaryllis* (*Sternbergia*) *lutea*, an autumn-flowering bulb, with bright yellow flowers, a native of Europe and Palestine, where it is abundant in the vales. It is, however, generally admitted that the lilies of the Bible cannot be identified with any special plant or plants, but that the term "lily" is a general one for all plants having open lily-like flowers of showy colours, thus including *Anemone*, *Ranunculus*, *Cornflag* and even *Iris* which are abundant in Palestine. Smith says that *Anemone coronaria*, with its brilliant colours, is the most conspicuous, and grows almost everywhere, without regard to soil or situation. It is abundant on the Mount of Olives and may well be considered to represent the "lilies of the field" that surpassed "Solomon in all his glory." The plant familiarly known as "Lily of the Valley" is not a native of Palestine and cannot therefore be the plant of this name referred to in the Bible.

In ancient mythology the lily was held to be sacred and was consecrated to Juno, of whom it was said "from the milk of her breasts sprang this beautiful flower." Ancient writers have made many references to it. Theophrastus (400 B.C.) says: "Krina show many variations in colour. . . . The plant has in general a single stem, but occasionally divides into two, which may be due to differences in position and climate. On each stem grows sometimes one flower, but sometimes more; for it is the top of the stem which produces the flower, but this sort is less common. There is an ample root, which is fleshy and round. If the fruit is taken off, it germinates and produces a fresh plant, but of smaller size; the plant also produces a sort of tear-like exudation which men sometimes plant." The lily was a favourite flower with Pliny who placed it second only to the rose. He says that it was much used for making an unguent called "lirinon," and from his description of the whole plant there is very little doubt that it was *Lilium*

[1] Canticles ii. 1.

candidum mentioned below. Pliny also describes a method of artificially producing crimson lilies from the bulbils of a white lily, a proceeding altogether improbable and ridiculous. During this period the Greeks and Romans used the flowers at many of their feasts, and the former placed crowns of them upon the heads of their brides, as emblems of purity and abundance. There appears to be no record of the introduction of this bulbous plant into Britain, but it is assumed that the early Crusaders brought it from Palestine.

Varieties.—The name *lily* is often given to pretty flowering plants in general, but in botany is restricted to the genus *Lilium*, of which there are many species, natives of the temperate zone of the Northern Hemisphere. They are showy flowering plants, favourites in gardens, and are represented by—

L. auratum, one of the most beautiful, some forms having flowers nearly 12 inches in diameter. The petals are broad and white with reddish-brown spots, and the centre is golden-yellow in colour. This species is a native of Japan, and bulbs are imported annually.

L. bulbiferum is a handsome specimen about 2 feet high, bearing large crimson flowers shaded to orange.

L. candidum is well known as the white or madonna lily, and is universally cultivated. It is one of the finest examples of this genus, and its perfume when flowering in the summer is fragrant, strong, and honey-like.

L. croceum, also known as the crocus or orange lily, is a hardy plant bearing in early summer huge heads of rich, large orange flowers.

L. gigantium is a noble species native of Nepal. The stems are erect and from 6 to 10 feet high. They terminate with a huge raceme, measuring 1 to 2 feet, and having many long nodding fragrant flowers which are white, tinged with purple in the inside.

L. longiflorum is one of the most valuable garden varieties, and is known as the white trumpet lily, on account

[*R. A. Malby.*

FIG. 42.—Lilies of the Valley.

[*To face page* 160.

of its large trumpet-like blooms of snow-white purity and delightful fragrance.

L. tigrinum, the tiger lily, is probably the commonest kind in our gardens, and some varieties commence to flower at the end of August, while others are as late as October.

The two examples following are included here for the sake of completeness, as the synthesis of their perfume resembles that of the above very closely.

Lily of the Valley is probably the favourite member of the N.O. Liliaceæ, on account of its exquisite fragrance. It is the single species of the genus *Convallaria*, known botanically as *C. majalis*, and on the Continent as *muguet*, or *lys*. It is a native of Europe, found generally in shady places in woods, and frequently grown in gardens for its pure, waxy, odorous flowers which blossom from April to June. There is a variety with golden-striped foliage, and another with double flowers, but these are not so pretty. The finest form is called *Fontin's*, which is more robust than the common kind and develops larger flowers. This species is not the lily of the valley spoken of by King Solomon. The lilies of the valley which are sold by the florists about Christmas time were at one time "forced" in Germany, but according to J. Gattefossé [1] the industry has been developed in France since 1890 and is now a thriving one. The flowers are grown from wild rhizomes bearing latent flower buds called *turions*, and it takes about three years' cultivation before they are ready for forcing, although by special treatment successful results are sometimes obtained at the end of one year. Forced roots soon become exhausted and will not produce new shoots.

Belladonna Lily is one of the most important members of the N.O. Amaryllidaceæ, and like the Guernsey lily, *A. sarniensis*, is a native of South Africa naturalised in the Channel Islands, from whence the bulbs are yearly imported to this country. The plant blooms late in the summer, and its flowers, which are of a delicate silvery rose colour,

[1] "La Parfumerie Moderne" (1917), 142.

exhale a most delicious fragrance, recalling apricots. Other varieties, such as *A. treatea* and *A. cinnamonea*, are said to be natives of Brazil, and are largely cultivated in this country.

Odour.—Different lilies, as we have mentioned, exhale slightly different odours, which in general may be described as delicate, elusive, and "as sweet as honey." The odour of ylang-ylang in *extreme dilution* is fairly representative of the type.

Natural Perfume.—This is extracted from *Convallaria majalis* by means of volatile solvents, and may be obtained as concrete or liquid absolute. Only small quantities are produced, and in preparing artificial lily perfumes the flowery note is generally obtained with other absolutes. Nothing is known concerning the composition of the lily odour. It is interesting to note, however, that Hænsel[1] has extracted the leaves of *Convallaria majalis* by steam distillation when he obtained 0·058 per cent of a semi-solid, greenish-brown volatile oil, having a pleasant aromatic odour.

Compounding Notes.—Hydroxy-citronellal is the finest base known for lily and muguet compounds, but before its discovery the majority of perfumes were based upon terpineol and linalol. These are still used in combination with the first-mentioned material, and much improve its odour. The proportions used vary with the type of perfume being imitated, and while terpineol and linalol predominate in white lily, they are employed in smaller quantities for muguet, and amaryllis, where the characteristic note is struck by hydroxy-citronellal. The floweriness of these bases is enhanced by the use of cyclamen aldehyde in fairly large proportions. Another synthetic of great importance is citronellyl formate which has a decided fresh lily odour. The typical green freshness is further improved by traces of methyl heptine carbonate or phenyl acetaldehyde dimethyl acetal. The modifiers and blenders are not numerous, but include ylang-ylang, citronellol, nerol,

[1] "Year Book of Pharmacy" (1902), 63.

ethyl phenylacetate, anisaldehyde, phenylethyl cinnamate, geraniol, heliotropin and *traces* of benzaldehyde and cardamon oil. The flowery note is obtained with natural jasmin and rose, while the most efficient fixative is civet. Other useful fixators are ambrette oil and ketone musk.

Synthetic Components:—

Bases.—Hydroxy-citronellal, linalol, terpineol.

Blenders.—Ylang-ylang, citronellol, nerol, ethyl phenylacetate, geraniol, phenylethyl alcohol, bois de rose, bergamot, rhodinol, cinnamyl acetate and butyrate, benzyl propionate, benzyl acetate, citronellyl formate.

Modifiers.—Alpha and methyl ionone, phenyl glycol acetate, cardamon, sweet orange, almonds, petitgrain, phenyl propyl alcohol, gamma undecalactone, methyl cinnamate, methyl heptine carbonate, phenyl acetaldehyde dimethyl acetal, sandalwood oil, orris, iso-butyl benzoate, phenylethyl salicylate, anisaldehyde, phenylethyl cinnamate, heliotropin.

Fixers.—Methyl naphthyl ketone, musk ketone, civet, benzyl cinnamate, benzoin, *p*-cresyl phenylacetate.

Florales.—Jasmin, rose, tuberose.

Aldehydes.—C_{11}, C_8, C_{10}, iso-propyl alpha methyl hydrocinnamic aldehyde, methyl hexyl acetaldehyde.

Formulæ illustrating the use of the above bodies are appended:—

Madonna Lily, No. 1062.

100	Terpineol.
150	Linalol.
250	Hydroxy-citronellal.
50	Amyl cinnamic aldehyde.
100	Citronellol.
30	Phenyl propyl alcohol.
10	Tuberose absolute.
50	Phenylethyl salicylate.
10	Neroli oil.
20	Ylang-ylang oil—Manila.
90	Jasmin, No. 1053.
100	Bergamot oil.
40	Para-cresyl phenylacetate.
1000	

Muguet, No. 1063.

350	Hydroxy-citronellal.
20	Ylang-ylang absolute.
150	Bois de rose oil.
150	Terpineol.
40	Citronellyl formate.
150	Rhodinol.
2	Cardamon oil, 1 per cent.
30	Jasmin absolute chassis.
5	Cyclamen aldehyde.
20	Civet extract, 3 per cent.
80	Heliotropin.
3	Methyl heptine carbonate, 10 per cent.
1000	

Amaryllis, No. 1064.

600	Hydroxy-citronellal.
40	Ylang-ylang oil—Manila
50	Santalwood oil.
30	Neroli oil.
10	Rose oil—Provence.
40	Ethyl phenylacetate.
20	Jasmin absolute.
190	Bois de rose oil.
1	Gamma undecalactone.
15	Musk ketone.
4	Vanillin.
1000	

Alcoholic Perfumes can be made by diluting any of the foregoing ottos, and it is usual to tint the perfumes so obtained with chlorophyll or organic dyestuff. When very flowery notes are desired jasmin absolute may be added. Before the introduction of several of the more recent synthetics it was customary to imitate the perfume of the lily by mixtures of tuberose, cassie, rose, jasmin, orange blossom, and vanilla with traces of bitter almond oil. Many readers will have noticed, however, that numerous old formulæ contain either cardamons or its essential oil. These appear to be modifications of a formula published in the "Chemist and Druggist" (1887), 247, as follows:—

Extract of jasmin	960 c.c.
,, ylang-ylang . . .	144 ,,
Cardamon seeds	48 grams.
Oil of orris *flower* . . .	1 c.c.

Accurate reproductions of the odour are said to be obtainable by this means.

Modern formulæ are as follows:—

No. 1065.

90	Muguet, No. 1063.
3	Rose absolute.
1	Cassie ,,
1	Orange blossom absolute.
5	Jasmin absolute.
900	Alcohol, 90 per cent.
1000	

No. 1066.

65	Madonna Lily, No. 1062.
10	Civet extract, 3 per cent.
5	Musk ,, ,,
10	Vanilla ,, 10 per cent.
3	Rose absolute.
7	Jasmin ,,
900	Alcohol.
1000	

MAGNOLIA.

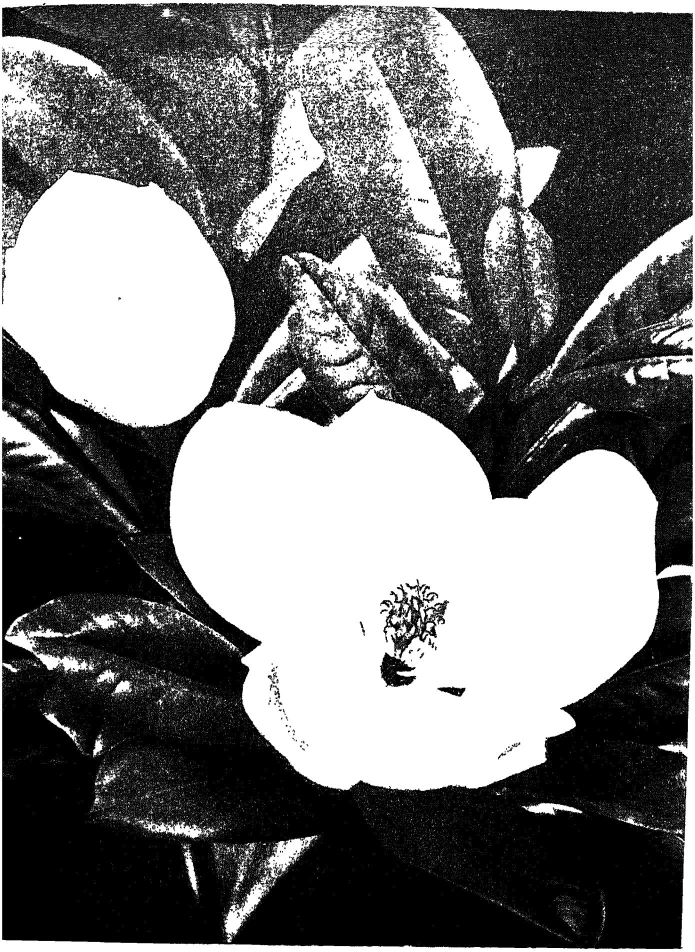
The genus *Magnolia* is named in honour of a professor of medicine and botany, Pierre Magnol, who died in 1715. It consists of about sixty species of conspicuous trees and shrubs, natives of China, Japan, and America, and probably also of the mountainous districts of Northern India. *M. grandiflora* appears to have been the first species to have been introduced into Europe, and was brought to France by the botanist Plumier about 1700 A.D.

Varieties.—The most important species is the great laurel-magnolia, *M. grandiflora*, a native of the Southern United States. It sometimes attains a height of 80 or 100 feet, and is evergreen, with firm laurel-like leaves. The flowers are yellowish-white in colour, and stand upright, in the form of a cup 6 to 8 inches in diameter. They are highly odoriferous, and in England are the largest flowers of any trees growing in the open air. Their perfume is said to be inferior to that of the native-grown blossom, which has a predominating note suggestive of ylang-ylang backed up with orange blossom. There are several varieties of this species.

M. conspicua is a native of China known as Yulan, and as its name indicates, it is probably the most conspicuous species. It is deciduous, and attains a height of 40 to 50 feet, much branched and has pure lily-like flowers, produced before the leaves expand in such profusion that at a distance it appears one compact sheet of white.

Magnolia glauca is native of the Eastern United States, where it is known as swamp sassafras, sweet laurel, and beaver tree. It is a pretty, sub-evergreen shrub, about 20 feet high, with leathery leaves, which are bluish-green above and silvery below. The flowers are globular in shape, delightfully fragrant, and at first have a rich cream colour which gradually changes to a pale apricot tint. The leaves are fragrant and have been examined by Rabak[1] who obtained a yield of 0·05 per cent of a pale yellow aromatic oil. A cursory examination suggested the presence of phenols.

[1] "Mid. Drugg." (1911), 45, 486, through "Year Book of Pharmacy" (1912), 95.



[*R. A. Malby*.

FIG. 43.—Magnolia Grandiflora.

[*To face page* 166.

M. Kobus is a native of Japan and is a comparatively small tree, only attaining a height of about 10 feet. The bark has a camphoraceous odour, and the flowers are fragrant (suggestive of verbena). An oil distilled from the twigs has been examined by Asahina and Nakamura, who found the constituents mentioned below. This essence is known as Kabushi oil.

Other important species are *M. macrophylla*, with open, bell-shaped flowers, white, with a purple blotch at the base of the inner petals; *M. acuminata*, the cucumber tree, with lemon-yellow flowers; *M. tripetala*, the umbrella tree; *M. auriculata* and *M. cordata*. The botany of the various species is dealt with in detail by Sawer ("Odoragraphia," II, 474).

Odour.—The perfume of the majority of species of the *Magnolia* is exotic, and the fragrance resembles that of ylang-ylang backed up with jasmin, orange blossom, and a lemon top note.

Natural Perfume.—Oils have been obtained from Japan, but the species of magnolia from which they were extracted does not appear to be very clear. A list is appended of those bodies identified,[1] but unfortunately they cannot be taken as a guide to the compounding of the synthetic perfume:—

Cineole.
Citral.
Anethol.
Eugenol.
Methyl chavicol.
Phellandrene.
Linalol.
Terpineol.
Caprinic acid.
Oleic acid.
And possibly pinene.

[1] "Report" of Schimmel & Co. (April, 1909), 59

Some time ago the *leaves* were steam distilled by Tomarasi[1] but the results obtained had very little practical significance.

More recently, G. Igolen[2] extracted the flowers of magnolia in the laboratories of Antoine Chiris. The fresh blossoms, immediately after collection, were treated with petroleum ether, yielding about 1·5 per cent of a greenish-yellow concrete of brittle texture and melting at 58° to 60° C. Distillation with steam gave 10 per cent of a semi-solid essential oil of similar colour.

Compounding Notes.—The majority of modern magnolia flower oils are based upon ylang-ylang oil or absolute. This is blended with a variety of substances to yield a sweet bouquet having considerable body, the former effect being obtained with lemon oil or citral and the latter with liberal quantities of the crystalline synthetics. Orange blossom absolute supplies the floral note which is enhanced by judicious additions of jasmin and jonquille. Amber fixatives with Peru balsam and benzyl iso-eugenol supply the necessary tenacity of odour.

Synthetic Components :—

Bases.—Ylang-ylang, cananga, guaiac-wood.

Blenders. — Verbena, lemon, lemon-grass, bergamot, sweet orange, petitgrain, citronellol, nerol, farnesol, linalol, terpineol.

Modifiers. — Anisic aldehyde, iso-eugenol, eugenol, methyl ionone, ethyl cinnamate, hydroxy-citronellal, vanilla, coriander, heliotropin.

Fixers.—Vanillin, coumarin, ketone musk, dimethyl hydroquinone, ambers, benzyl iso-eugenol, Peru balsam, tolu, benzylidene acetone.

Florales.—Orange blossom, tuberose, rose, jasmin.

Aldehydes.—C_{14}, amyl cinnamic, phenyl propyl, C_{12}.

[1] "Rivist. Ital. Prof.," 10 (1928), 156.
[2] "Les Parfums de France" (1938), 33.

A formula is appended :—

Magnolia, No. 1067.

350	Ylang-ylang oil—Bourbon.
150	Guaiac-wood oil.
5	Lemon oil, terpeneless.
50	Bergamot oil.
100	Linalol.
20	Anisic aldehyde.
15	Eugenol.
30	Methyl ionone.
20	Hydroxy-citronellal.
5	Rose otto.
20	Orange blossom absolute.
60	Benzyl acetate.
10	Tuberose absolute.
4	Amyl cinnamic aldehyde.
1	Gamma undecalactone.
10	Ethyl protocatechuic aldehyde.
30	Musk ketone.
70	Heliotropin.
50	Peru balsam.
1000	

Alcoholic Perfumes may be made from the above as follows :—

No. 1068.

70	Magnolia, No. 1067.
5	Lauric aldehyde, 1 per cent.
5	Phenyl propyl aldehyde, 1 per cent.
10	Musk extract, 3 per cent.
10	Civet „ „
900	Alcohol, 90 per cent.
1000	

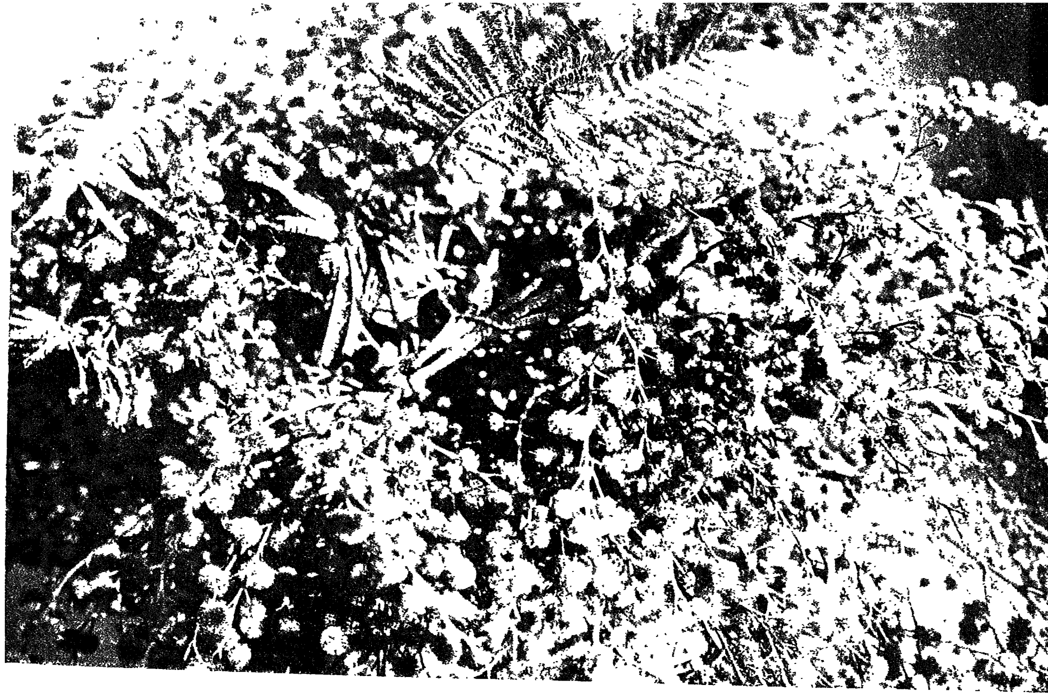
MIMOSA.

History.—Numerous species of *Acacia* (N.O. Leguminosæ), known commercially as mimosa, are indigenous to Australia and certain parts of Africa. There is no clear record of their introduction to the southern part of Europe, but they appear to have been first cultivated in the neighbourhood of Cannes—Mandelieu—Vallauris about 1820, having been introduced from Australia. It has also been stated that the seeds were brought by Captain Ardisson from San Domingo in Hayti and that the plants were first grown in the region of Tanneron in 1839. To-day there are over 30 varieties cultivated on the Cote d'Azur, which cover an area of 1500 hectares, and the cut branches are sold principally as cut flowers. Most of these blooms are "forced," this industry having been started by Jacques Tournaire. The method used consists in subjecting the unopened flowers to the action of a humid atmosphere at a temperature of about 25° C., special apparatus being used for the purpose. Forcing takes from 2 to 8 days according to season. The trade is so extensive that a special train leaves Mentone daily in January and February, and conveys to Paris large quantities of this favourite flower. Consignments average about 600,000 baskets of flowers each season. The principal centres now supplying mimosa for decoration purposes are: Antibes, Biot, Cannes, Le Cannet, Frejus, Golfe-Juan, Mandelieu, Saint-Raphael, Théoule, Le Trayas, and Vallauris. Recently many plantations of new varieties have been laid out in the districts of Tanneron, Pegomas, Auribeau, Mandelieu, Croix des Gardes, California, and the Esterel. The new varieties most favoured are known locally as "Bon Accueil" and "Motteana". Visitors to the Riviera in February will have been charmed with the delicious fragrance and picturesque appearance of the mimosa trees as the train wends its way along the red rocky coast between Saint-Raphael and Cannes.

Varieties.—All the mimosas have compact globose heads of fragrant yellow blossoms. The trees vary in height from about 18 to 30 feet. From the perfumer's point of view the following two species are of greatest value and most highly odorous:—

Acacia floribunda whose perfume approaches that of cassie.

A. dealbata having a slightly coarser odour and resembling ylang-ylang.



[*A. Chiris.*

Fig. 44.—Mimosa in Flower.

[*To face page* 170.

[A. Chiris.

FIG. 45.—An Avenue of Mimosa at Grasse.

[Roure-Bertrand Fils.

FIG. 46.—Sorting Mimosa.

[To face page 171.

In addition to these two the following species yield cut flowers for decorative purposes :—[1]

Acacia albicans or *Cultiformis*, with its bright golden-yellow flowers, forming some magnificent bunches of berries.

A. Trinervis, with cylindrical clusters of yellow flower chenilles, very pretty and original.

A. petialaris, of rapid growth and beautiful golden-yellow flowers.

Odour.—The perfume of mimosa is faint (in small bunches) but charming, and resembles cassie, especially in *A. floribunda*, while in *A. dealbata* it distinctly recalls the odour of ylang-ylang. Several branches in a closed room give an overpowering fragrance.

Natural Perfume.—The mimosas from which the perfume is extracted come from the following districts and in a good year yield approximately the weight of blooms appended :—

Auribeau, Biot, Cannes, Mougins, Pegomas	30,000 kilos.
Tanneron	30,000 „

The flowers are collected mainly for sale as cut flowers from the middle of January to the end of March and by the middle of April this trade has practically ceased. It is, however, after this period that the tree flowers most freely when the blossoms are more highly scented and open, and in consequence are received at the Grasse works in greater quantities where they are extracted by the volatile solvent process (distillation and maceration yield unsatisfactory and inferior products), the yield of concrete being from 0·7 to 0·8 per cent. from which about 20 per cent of absolute is obtained (equivalent to about 9 per cent of colourless absolute). About 50,000 kg. of flowers are extracted annually. The product of *A. floribunda* is a viscous, oily liquid, while that of *A. dealbata* contains a higher percentage of wax and is concrete. Both absolutes have an intensely sweet honey-like odour, reminding of orris, are comparatively cheap and give excellent results in floral

[1] "Les Parfums de France" (1925), 28.

Colognes (*which see*), while in " de luxe " perfumes, particularly honeysuckle and heliotrope, they give floral notes which are unique : very fine bouquets of honey-like odour can be obtained by combination with muguet or jasmin.

Chemistry.—Very little is known of the chemistry of these oils, but in 1904, H. von Soden [1] distilled with steam an absolute prepared with volatile solvents and, calculated as fresh flowers, obtained 0·018 per cent of yellowish-green oil, which solidified in ice into a mass of crystalline leaflets.

Recently mimosa perfume has been studied by Sabetay and Trabaud,[2] who have identified the following constituents : anisic acid, palmitic acid, acetic acid esters, palmitic aldehyde, a primary alcohol, and large quantities of unsaturated aliphatic hydrocarbons.

Compounding Notes.—Many commercial mimosa oils are mixtures of synthetics without any natural floral extracts, and although good results are obtained by this method, the use of 10 per cent of mimosa absolute makes all the difference to the smoothness and fixity of the blended mixture. This quantity may be considered by some chemists to be a rather large allowance, but it must be borne in mind that mimosa absolute is comparatively cheap and it has rather a weak odour but unique fixative powers. In extreme dilution there is one substance whose odour closely resembles that of the natural flower. This is para-methyl acetophenone, and when used, great care is necessary as it is exceptionally powerful, and if employed in excess will soon cover any bodies which may have been added as modifiers. In consequence 10 per cent should not be exceeded. The harsh odour of this synthetic may be toned down very considerably by mixation with hydroxy-citronellal and terpineol. It may be blended and sweetened with liberal additions of bergamot or linalyl acetate and modified with phenylacetic aldehyde, ylang-ylang, and anisic aldehyde. The floral note is obtained with rose, jasmin, mimosa, and cassie absolutes, while fixation is

[1] "Report" of Schimmel & Co. (1926), 75.
[2] "P. and E.O.R." (1940), 120.

completed by the addition of cinnamic alcohol, balsam of Peru, amyl cinnamic aldehyde, or artificial musks.

Synthetic Components :—

Bases.—*p*-methyl acetophenone, terpineol, hydroxy-citronellal.

Blenders. — Bergamot, linalol, linalyl acetate, sweet orange, nerol, farnesol, benzylidene acetone, alcohols C_{11} and C_{12}, guaiac-wood oil.

Modifiers. — Phenylacetic aldehyde, ylang—Bourbon, orris, anisic aldehyde, α-ionone, rhodinyl butyrate, methyl salicylate, phenylethyl alcohol, methyl anthranilate, anisic alcohol, citronellyl and phenylethyl iso-butyrates, methyl heptine carbonate, heliotropin.

Fixers. — Cinnamic alcohol, methyl naphthyl ketone, Peru balsam, ketone musk, iso-eugenol, amyl cinnamic aldehyde, tolu, civet, methyl anisate.

Florales.—Mimosa, cassie, jasmin, rose.

Aldehydes.—Phenyl propyl, C_{10}, C_{12}.

Two formulæ follow :—

Mimosa, No. 1069.

70	Para-methyl acetophenone.
120	Hydroxy-citronellal.
180	Terpineol.
50	Cassie artificial.
30	Rose ,,
70	Jasmin ,,
45	Ylang-ylang oil—Bourbon.
25	Balsam Peru.
75	Cinnamic alcohol.
50	Mimosa absolute—liquid.
130	Bergamot oil.
20	Anisic aldehyde.
30	Rhodinyl butyrate.
15	Phenylacetic aldehyde.
10	Amyl cinnamic aldehyde.
30	Musk ketone.
50	Heliotropin.
1000	

Mimosa, No. 1070.

10	Iso-eugenol.
80	Dimethyl acetophenone.
150	Muguet, No. 1063.
10	Cuminic aldehyde.
40	Benzyl acetate.
200	Geraniol.
150	Terpineol.
50	Cananga oil, terpeneless.
20	Methyl anthranilate.
200	Guaiac-wood oil.
20	Phenylacetic aldehyde.
50	Linalyl acetate.
20	Musk ketone.
1000	

Alcoholic Perfumes are obtained from the above as follows :—

No. 1071.

70	Mimosa, No. 1069.
1	Orris oil concrete.
9	Benzoin R.
10	Musk extract, 3 per cent.
2	Rose absolute.
5	Jasmin ,,
3	Cassie ,,
900	Alcohol.
1000	

These may also be made from the absolute as follows :—

No. 1072.

40	Mimosa absolute.
3	Cassie ,,
20	Bergamot oil.
1	Vanillin.
2	Coumarin.
1	Heliotropin.
4	Anisic aldehyde.
2	Orange blossom absolute
10	Hydroxy-citronellal.
7	Ylang-ylang oil.
10	Civet extract, 3 per cent.
900	Alcohol.
1000	

NARCISSUS.

History.—There are botanical references to this beautiful genus in the works of Theophrastus, but it is to Ovid that we owe the story of its creation. In his "Metamorphoses," Book III, he tells us that Cephisus, the river god, bore a beautiful child named Narcissus, and when Tiresias, the seer, was asked if he would live to a ripe old age he replied, "If he ne'er know himself." Mirrors were kept from him, and the saying of the prophet seemed but empty words, for Narcissus had reached the age of sixteen, and many maidens sought his love. But he was proud and cold, and so slighted the affections of Echo, the nymph, that she hid in the woods, became gaunt and faded until only her voice remained. Narcissus went to a pool one day to quench his thirst, and while there another thirst sprang up, for while he drank, he was smitten by the sight of the beautiful form he saw reflected in the water and fell passionately in love with it. He attempted to clasp it in his arms, but after fruitless efforts killed himself in desperation. When he had been received into the infernal abodes, he kept on gazing at his image in the Stygian pool. His naiad sisters beat their breasts and shore their locks in sign of grief for their dear brother. When they prepared the funeral pile, the torches, and the bier, his body could not be found, but in its place was a flower, its yellow centre girt with white petals. That flower into which he had been changed still bears his name! Pliny does not agree with this fable, but states [1] that the herbaceous narcissus [2] produces dull, heavy pains in the head and in consequence derived its name from "Narce" (torpor or lethargy). He mentions three varieties of flowers and in another book [3] speaks of an emetic bulb which commentators have identified as that of *N. Jonquilla*.

The narcissus is stated to have been brought to this country by the Romans.

[1] Book XXI, chap. 75. [2] *N. pseudo-narcissus.*
[3] Book XX, chap. 41.

Varieties.—Narcissus is the botanical as well as the familiar English name for a genus of bulbous plants of the N.O. Amaryllidaceæ, of which there are about 20 species. The following are worthy of note :—

N. bulbocodium is a species having slender, rush-like leaves, and is known as the hooped petticoat daffodil. In Spain it flourishes in wet meadows during the winter and spring, but disappears at other times. Here the colour is golden-yellow, while in Southern France it is sulphur-yellow.

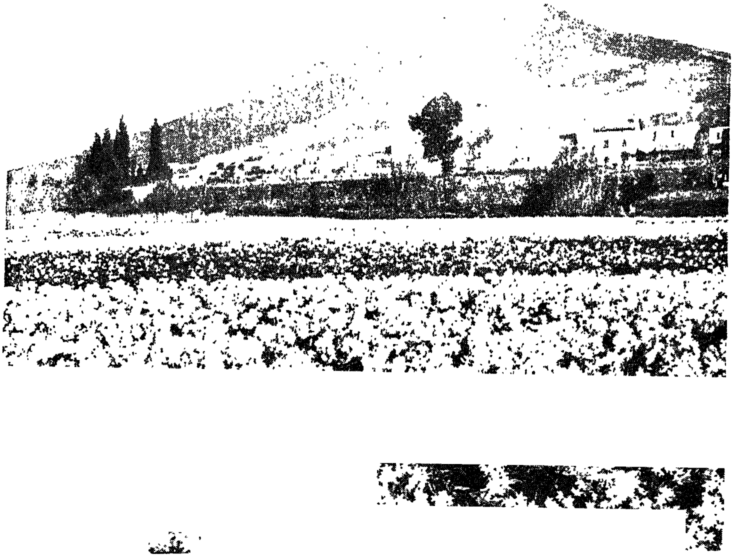
N. Jonquilla is known as the rush daffodil or jonquille, and is often found in our gardens, the bulbs being imported from Holland and Italy for forcing in pots. This fragrant plant is one of the most powerfully scented of all the genus, and a few blooms are sufficient for perfuming a large room.

N. Poeticus, poet's or pheasant's eye narcissus, is one of the oldest and most charming varieties, being widely distributed in Europe from the Pyrenees to Germany. It flowers from April to June. *Gardenia narcissus* is an elegant double variety grown largely for the London markets.

N. Pseudo-narcissus, the common daffodil, of which there are hundreds of varieties, both growing wild and under cultivation. They are divided into three principal kinds, golden, bicolors, and sulphur and white.

N. tazetta, the polyanthus or bunch-flowered narcissus, is a native of Southern Europe and Western Asia, being abundant in Palestine, and during the flowering season it is to be found in nearly every house, especially in Damascus. By some it is considered to be the rose of Sharon, the original Hebrew word bulb being translated rose, and indeed a rosebud is something similar to the bulbs of this plant. It is the classic narcissus of Homer, Ovid, and other poets, both Greek and Roman. In China the flower is held to be sacred, and is known as the joss flower or sacred lily. The plant from each bulb bears tall, many-flowered, charming lily heads of from six to twenty-four large yellow or yellowish-white flowers. They are powerfully fragrant and recall the odour of jonquille.

The majority of the narcissi and jonquilles sold by the



[*La Parfumerie Moderne.*

FIG. 47.—Narcissus cultures at Carquieraine (Var.). Exceptional flowering season of the year 1921.

florist in London during March come from the Scilly Isles. Here a large proportion of their income is derived from flower growing, and especially so at St. Mary's where the blossoms are cut before they open, the forcing being carried out in steam-heated pits.

Odour.—Most of the species of this genus exhale perfumes which differ but slightly, and they have been described as resembling that of the violet with the sweetness of the lily. A suggestion of hyacinth is usually noticeable.

Natural Perfume.—In the south of France the cultivation of both narcissus and jonquille has fallen off until the last year or two. The increased demands of the perfumer for the natural perfume of these two flowers has given some encouragement to the cultivator, who until recently has found it scarcely worth while to pay any attention to them owing to the poor price paid for the blossoms. In 1924 the harvest yielded about 80,000 kg. of narcissus and about 5000 kg. of jonquille. The principal centres for the cultivation of the former are: Caille, Cogolin, Grasse—Magagnosc, Hyères and Tourettes; and for the latter: Grasse, Peymeinade, and Tanneron. Fresh plantations of jonquille as well as important improvements in the old ones have been made in the communes of Peymeinade, Tanneron, Callian and Montauroux. A large quantity of the narcissus is sold as cut flowers for decorative purposes. It is known locally as "*Done*".

The principal species cultivated for perfumery purposes is *N. Tazetta*. Nowadays *N. Poeticus* is mainly used, since it grows fairly profusely in the higher regions around Grasse and the only cost is that of transport. The crop is collected during April and May. According to a French periodical,[1] *N. odoris*, Willd., and *N. Joncifolius* are also grown but are generally left aside since their perfume is weak and suggestive of jonquille. The narcissus is extracted by volatile solvents and the yield of concrete is

[1] "Les Parfums de France," 26 (1925), 84.

about 0·3 per cent. which in turn gives about 30 per cent of absolute.

The jonquille flowers yield a much more powerful perfume. The bulbs are planted out in rows in the autumn and towards the end of March the blossoms appear —four or five bright yellow flowers on each stem. Each bloom is cut off separately and a woman will collect from 400 grams to 1 kilo in an hour according to the density of the flowers. If good results are desired the bulbs have to be replaced every two or three years. Jonquille flowers are extracted by volatile solvents and yield about 0·3 per cent of concrete which in turn gives over 40 per cent of absolute. They are used in the proportion of 3 of flowers to 1 of fats when extracted by maceration. The perfume is also isolated by means of enfleurage. In Holland large quantities of *N. Poeticus* are now grown for perfumery purposes and the blossoms are extracted by the volatile solvent process by a well-known firm at Roermond. The indoloid character of the absolute makes its use in fine perfumes rather risky owing to discoloration. This is minimised by the employment of the decolorised product—a fine, flowery and powerful asset.

Chemistry.—The flowers of yellow narcissus were extracted with volatile solvents by H. von Soden [1] who then distilled the product with steam. Calculated as fresh flowers, he obtained 0·0068 per cent of an oil having an odour of narcissus, so narcotising as to cause headache. This chemist treated jonquille flowers in a similar manner and obtained a yield of 0·1577 per cent of a colourless oil which rapidly became yellowish-brown on exposure to air. A chemical examination indicated the presence of the following substances : methyl and benzyl benzoate, indole, methyl anthranilate, esters of cinnamic acid—particularly the methyl ester and probably also linalol. A further investigation of the jonquille perfume was made by Elze [2] who suspected the

[1] "J. f. prakt. Chem." N.F., 110 (1925), 278.
[2] "Riechstoffindustrie," 3 (1928), 154.

presence also of eugenol, geraniol, nerol, farnerol and jasmone. The chemistry of these two flower oils is thus still comparatively vague, but judging by the odour the following substances might also be present :—

Benzyl acetate
Para-cresol or derivatives
Phenylethyl esters.

Compounding Notes.—*Narcissus* floral oils are compounded with para-cresyl *phenylacetate* or *iso-butyrate* as their base, but if this is not available para-cresyl *acetate* may be used. The results obtained with the latter are not so satisfactory, as there is usually an odour suggestive of urine, even when employed in the pure state and in small quantities. Both materials are exceedingly powerful, and the odour of the phenylacetate is smoother and softer. It is customary to blend either of these products with terpineol, iso-eugenol, and phenylacetic aldehyde, and for this purpose linalol is also useful. Phenylethyl alcohol, ionone, and methyl anthranilate are often employed as modifiers, while good results may be obtained with benzyl acetate and heliotropin. Flowery notes are struck by the inclusion of natural absolutes of narcissus, jasmin, tuberose, rose, and neroli, and fixation is completed with either benzoin, methyl naphthyl ketone, acetyl iso-eugenol, indole, or artificial musk. *Jonquille* oils resemble the above in practical perfumery, but the base differs in that *phenylethyl*-phenylacetate is used. Another slight odour modification is necessary, and this is obtained by the employment of traces of basil and patchouli, and of course jonquille absolute ; otherwise fixation may be accomplished on the same lines as for narcissus.

Synthetic Components :—

Bases.—*p*-cresyl acetate and phenylacetate, phenylethyl phenylacetate, *p*-cresyl iso-butyrate, iso-eugenol.

Blenders.—Linalol, terpineol, phenylacetic aldehyde, hydroxy-citronellal, bergamot, geraniol, nerol, styrolyl valerianate, cinnamyl valerianate, phenylethyl cinnamate, cinnamic alcohol.

Modifiers.—Ionones, rhodinyl acetate, benzyl acetate, heliotropin, phenylethyl acetate, methyl anthranilate, phenylethyl alcohol, French petitgrain, para-cresol methyl ether, basil, patchouli, octyl acetate, ylang, cananga, phenyl acetaldehyde.

Fixers.—Benzoin, ketone musk, vanillin, civet, labdanum, indole, methyl naphthyl ketone, acetyl iso-eugenol.

Florales. — Jonquille, narcissus, jasmin, neroli, rose, tuberose.

Aldehydes.—Phenyl propyl, C_8, C_{10}, C_{12}.

Formulæ follow :—

Narcissus, No. 1073.

70	*p*-cresyl phenylacetate.
10	*p*-cresyl iso-butyrate.
200	Terpineol.
100	Linalol.
100	Geraniol.
200	Hydroxy-citronellal.
50	Iso-eugenol.
30	Ylang oil—Manila.
50	Petitgrain oil—French.
20	Phenylethyl cinnamate.
20	Benzyl iso-butyrate.
40	Phenyl acetaldehyde.
10	Indole, 10 per cent.
100	Heliotropin.
1000	

Jonquille, No. 1074.

300	Phenylethyl phenylacetate.
50	Phenylacetic aldehyde.
50	Cinnamyl acetate.
50	Iso-eugenol.
10	Opoponax R.
50	Ethyl furfurhydracrylate.
30	Jonquille absolute.
10	Jasmin ,,

10	Orange blossom absolute.
350	Bois de rose oil.
30	Iso-butyl phenylacetate.
10	Alcohol C_{10}.
20	Methyl cinnamate.
30	Musk ketone.

Alcoholic Perfumes may be prepared from the foregoing by dilution with alcohol as follows :—

Narcissus, No. 1075.

75	Narcissus, No. 1073.
3	Jasmin absolute.
5	Jonquille ,,
2	Tuberose ,,
5	Narcissus ,,
10	Civet extract, 3 per cent.
900	Alcohol.
1000	

Jonquille, No. 1076.

80	Jonquille, No. 1074.
5	Jasmin absolute.
5	Musk extract, 3 per cent.
10	Civet ,, ,,
900	Alcohol.
1000	

NEW-MOWN HAY.

History.—Hay is not a charming thing to look upon and does not therefore appear to have inspired the ancient poets. The word, however, occurs in the early scriptural writings, but it seems doubtful whether the reference is to cut hay as we know it to-day. Thus in Isaiah :[1] "The *hay* is withered away, the grass faileth, there is no green

[1] xv. 6 ; 726 B.C.

thing." Again in Proverbs:[1] "The *hay* appeareth, and the tender grass showeth itself."

In both cases the inference is that the plants are growing. Furthermore, in Palestine the cutting, drying, and stacking of grass does not appear to be practised.

Pliny devotes a whole chapter[2] to details concerning haymaking, but there is no reference to the odour so noticeable while the plants are drying.

The Plants.—The peculiar fragrance of freshly cut hay is at once charming and unique. Many fodder grasses grow spontaneously in our pastures, but several are especially cultivated and include *Lolium perenne*, *L. italicum*, *Phleum pratense*, *Poa pratense*, *Cynosurus cristatus*, and *Anthoxanthum odoratum*. The latter, also known as sweet-scented vernal grass, contributes more towards the characteristic odour of the hayfields than the others, and peculiarly enough the odoriferous constituents are only developed in the stem when dried. Among other plants in which the hayfields perfume is noticeable are the following:—

Alyssum compactum.—Sweet alyssum bears small white flowers, and the plant is particularly fragrant after a shower of rain.

Asperula odorata, woodruff, is a wild perennial of the N.O. Rubiaceæ, growing in shady places near woods. The plant flowers in May, and the small white blossoms are profusely distributed over the tufts of whorled leaves. The odour is emitted by the stem and leaves when dry, and in Germany these are put into wine to give it a distinctive flavour. There are other varieties with rose-blue flowers.

Liatris odoratissima is an evergreen plant thriving in the swamps of North America, where it is known as the vanilla plant, although it has no connection with the vanilla of commerce. According to Donald McDonald,[3] the leaves are disagreeable when fresh, but develop a delightful fragrance, resembling tonka bean, when dry. They are used

[1] xxvii. 25; 700 B.C.
[2] Book XVIII, chap. 67.
[3] "Fragrant Flowers and Leaves" (1895), 66.

for flavouring cigars. Coumarin was at one time extracted from the leaves of this species.

Liatris spicata is also a native of North America and belongs to the N.O. Compositæ. Some years ago[1] it was cultivated at Marseilles by M. Davin and found useful for perfuming tobacco, linen, etc. Apparently it contains less coumarin than the above-mentioned species and is therefore not so valuable.

Melilotus officinalis, the common melilot, is a clover-like annual or biennial of the N.O. Leguminosæ, and when withered by the sun is almost as fragrant as the woodruff.

Melilotus alba, known as Bokhara clover, is used chiefly for bee-feeding on account of the honey found in the white blossoms. The seed and dried leaves are perfumed.

The Natural Perfume is due to the presence of coumarin, which is formed while drying by the action of a ferment on a constituent of the plant.

Chemistry.—Bourquelot has shown that this constituent is probably *d*-glucose and the ferment probably emulsin. The experiments leading to this conclusion are described in a well-known American paper.[2]

Some peculiar facts concerning the liberation of the coumarin were brought to light by Heckel.[3] In the course of experiments with anæsthetics he was able to show that chloroform and ethyl ether immediately set free this lactone from the leaves of *Liatris spicata*. In the case of *Anthoxanthum odoratum* similar liberation only took place after 10 mins., but when a mixture of methyl and ethyl chlorides was employed, the separation of the coumarin was effected at once. Similar experiments were conducted with *Melilotus officinalis*.

Compounding Notes.—As coumarin is largely responsible for the odour of new-mown hay, we should expect

[1] "La Parfumeric Moderne" (1910), 77.
[2] "American Perfumer" (1922), 57.
[3] "Comptes Rendus," 149 (1909), 829.

to find it in foin coupé perfumes. It is used from 10 to 20 per cent, and the basic odour is completed by adding about double that amount of lavender and bergamot oils. Dimethyl hydroquinone is a body having an odour of the coumarin type and is well suited to take its place, or to blend with it, especially if a new and inimitable note is desired. The true reproduction of the odour is only possible by the employment of these bodies, although some perfumers use amyl salicylate and anisic aldehyde with coumarin, when the resulting odour resembles trèfle rather than foin coupé. When the former basic combination is used the most valuable modifiers are: methyl salicylate, ylang-ylang, oakmoss, and clary sage. They are employed in quantities varying between 1 and 10 per cent. The blend may be varied with diphenyl oxide, ionone, cuminic aldehyde and benzyl acetate. The floral note is given to hay bouquets by additions of almost any of the flower absolutes depending on the type under consideration and the taste of the experimenter—natural tonka bean absolute is now available and it gives a softness to the odour, much improving the familiar coumarin smell. The fixation of this perfume is not difficult since so many of the usual ingredients have high boiling-points and thus act as fixators. Patchouli and vetivert, artificial musks, benzoic acid, vanillin, and benzoin are invaluable.

Synthetic Components :—

Bases.—Coumarin, dimethyl hydroquinone, bergamot, lavender, tonka bean absolute.

Blenders.—Bois de rose, geranium, santal, rhodinol, geraniol, verbena, lemon, neroli, heliotropin.

Modifiers.—Clary sage, anisic aldehyde, amyl and methyl salicylates, ionones, acetophenone, oakmoss, ylang-ylang, benzyl acetate, benzophenone, benzylacetone, cuminic aldehyde, clary sage.

Fixers.—Patchouli, vetivert, vanillin, hydroxy-citronellal, diphenyl methane and oxide, benzoin, ketone musk, civet, tolu, methyl naphthyl ketone, acetanisol, benzoic acid.

Florales.—Jasmin, rose, orange blossom, tuberose, jonquille.

Aldehydes.—Methyl nonyl acetic, phenyl propyl, C_9, C_{12}.

Formulæ follow :—

New-Mown Hay, No. 1077.

50	Dimethyl hydroquinone.
200	Lavender oil.
250	Bergamot oil.
50	Methyl salicylate.
10	Clary sage oil.
50	Ylang-ylang oil—Bourbon.
20	Oakmoss absolute, green.
30	Tonka bean absolute.
10	Patchouli oil.
5	Vetivert oil.
50	Linalol.
10	Benzyl acetate.
200	Hydroxy-citronellal.
5	Diphenyl oxide.
30	Coumarin.
10	Vanillin.
20	Musk ketone.
1000	

Foin Coupé, No. 1078.

200	Coumarin.
100	Amyl salicylate.
50	Iso-butyl phenylacetate.
60	Lavender oil.
30	Anisic aldehyde.
20	Iso-butyl benzoate.
30	Ionone alpha.
100	Jasmin, No. 1053.
10	Clary sage oil.
40	Vetivenyl acetate—Java.
10	Methyl nonyl acetaldehyde, 10 per cent.
50	Acetanisol.
150	Bergamot oil.
30	Mimosa absolute.
100	Santalwood oil.
20	Oakmoss absolute.
1000	

Alcoholic Perfumes may be made by simple dilution of the above ottos, as follows :—

No. 1079.

60	Foin coupé, No. 1078.
10	Jasmin absolute.
2	Rose ,,
1	Cassie ,,
2	Tuberose ,,
5	Civet extract, 3 per cent.
20	Musk extract, ,,
900	Alcohol.
1000	

ORANGE BLOSSOM.

History.—The orange tree is very probably a native of Northern India, but there is no definite indication of the date it was brought into the Western Hemispheres, although this is believed to be about the ninth century. There is one reference in the Scriptures[1] which reads—"a word fitly spoken is like *apples of gold* in pictures of silver." From this, some have presumed that oranges were referred to, but according to different commentators the fruit was not cultivated in Palestine at the time of Solomon. The orange is not mentioned by the early Greek and Roman writers and it must be presumed therefore that it was unknown to them. The Arabs seem to have brought the trees from India, first to Africa, Arabia, and Syria and later to Italy, Spain, and Sicily. Avicenna, an Arabian doctor, who flourished at the commencement of the tenth century, appears to have employed the juice of the orange medicinally.

According to Fluckiger and Hanbury[2] there is strong evidence to show that the orange first cultivated was the *bitter* orange. The orange tree at Rome, said to have been planted by St. Dominic, A.D. 1200, and which still exists at

[1] Prov. xxv. 11 ; 700 B.C.
[2] "Pharmacographia," 2nd edn. (1879), 125.

[*A. Chiris.*

Fig. 49.—Provence Orange Trees in full bloom.

[*To face page* 186.

[A. Chiris.

FIG. 50.—Collecting Orange Blossom.

[To face page 187.

the monastery of St. Sabina, bears a *bitter* fruit, and the ancient trees standing in the garden of the Alcaza at Seville are also of this variety. These authorities also state that the sweet orange began to be cultivated about the middle of the fifteenth century, having been introduced from the East by the Portuguese. It has probably long existed in Southern China, and may have been taken thence to India. One of the first importations of the fruit into Britain was in A.D. 1290 when the Queen of Edward I bought some of the cargo of a Spanish ship at Portsmouth.

Orange blossoms have for centuries been worn at weddings. The origin of this custom is attributed by Brewer[1] to the Saracens, whose brides used to wear orange blossom as a sign of fecundity. The custom was introduced to Europe by the Crusaders.

The mythological conception of the fruit has always been associated with the hymeneal altar. The orange is by many supposed to be the golden apple presented by Jupiter to Juno on the day of her nuptials. The apples could be preserved nowhere but in the garden of Hesperides, where they were protected by three nymphs bearing that name, the daughters of Hesperus, and by a more effectual and appalling guard, a never-sleeping dragon. It was one of the labours of Hercules to obtain some of these golden apples. He succeeded, but as they could not be preserved elsewhere, it is said they were carried back again by Minerva.

As far back as the sixteenth century the Italian philosopher Porta obtained what he described as an oil of exquisite fragrance by distilling flowers of the citron tribe. About 1680 the oil from orange flowers was called essence of neroli from the fact that it was used for perfuming gloves by the wife of Flavio Orsini, prince of Neroli.

The orange trees are now much cultivated in Europe for both their flowers and fruit. In China, and particularly at Canton, the blossoms are collected when fully expanded and are used for scenting tea known as Orange Pekoe.

[1] Friend's "Flower Lore" (1883), 112.

Varieties.—*Citrus aurantium* is a low, much-branched tree of the N.O. Rutaceæ. It attains a great age, and in some parts of Spain is stated to be 600 years old, while one growing in a box at Versailles is said to have been planted in 1421. In Spain, Portugal, and Italy the plants are cultivated for their fruit, but in the south of France they are grown almost exclusively for their flowers. Here they are grown from pips, and the young plants are grafted when about three years old. When the seedling is about 4 ft. high it is transplanted and allowed a year to gain strength before being grafted. The cultivation of the plant requires much attention, and a crop of flowers is not expected before the fourth year after transplantation.

In a good year an orange tree will yield from 12 to 15 kilos of flowers and these are collected principally by women and children. According to "Les Parfums de France"[1] the normal yield of flowers for the larger districts around Grasse are as follows :—

Golfe-Juan-Vallauris . . .	700,000 kgs.
St. Laurent-du-Var . . .	180,000 „
Le Bar-Gourdon	150,000 „
Le Cannet	105,000 „
Vence	100,000 „
St. Jeannet	90,000 „
Mongins	84,000 „
Biot	71,000 „
Antibes	63,000 „

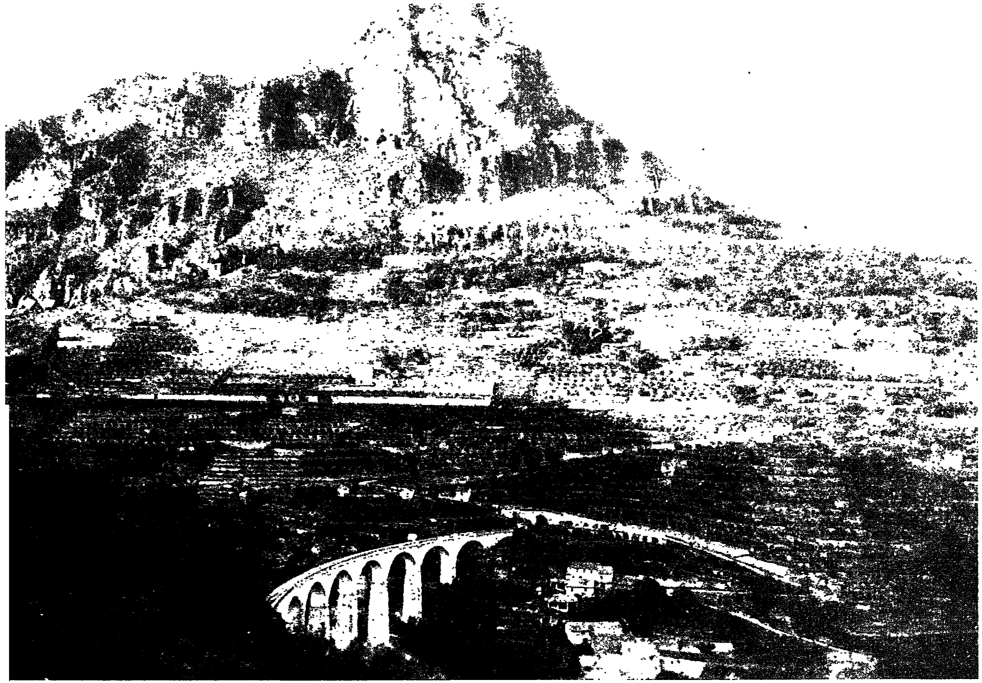
The total crop is about two million kilogrammes, but this figure has been exceeded in exceptional years.

At Boufarik in Northern Africa the orange tree is much cultivated and the yield of flowers is generally about 150,000 kgs.

The sweet or Portugal orange is the *Citrus aurantium* of Risso, who enumerates nineteen varieties.

The bitter or Seville orange is the *Citrus Bigaradia*, Duhumel; *C. aurantium*, var. *amara* Linnæus; and *C. vulgaris* of Risso, who describes twelve varieties. These are, however, in every respect superior to the former kind.

[1] 17 (1924), 169.



[A]; *Chiris.*

FIG Orange Gro G:

face page 188.

content increases, while the linalol diminishes. These chemists observed no marked difference in the constitution of the oil derived from the petals alone and that of the other floral organs, but the petal oil always contained slightly more methyl anthranilate.

Jeancard and Satie[1] have observed that in the distillation of orange blossom the yield of oil during harvest-time increases in good weather towards the end of May, but, on the contrary, diminishes on rainy days.

As mentioned above, orange blossom is collected in October as well as May and a comparative examination of the two products has been made by Roure-Bertrand Fils.[2] In each case they extracted 300 kilos of flowers with petroleum ether, the spring flowers yielding 0·2272 and the autumn flowers 0·1795 per cent of concrete. The essential oil was isolated by steam distillation. The direct oil and that dissolved in the water were examined separately, with the following results (abridged) :—

	Oil Collected in the Receiver.		Oil Dissolved in the Water.		Total Yield.	
	May.	Oct.	May.	Oct.	May.	Oct.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Yield . . .	0·0659	0·0611	0·0077	0·0052	0·0736	0·0663
Esters (as linalyl acetate) . .	25	33·8	21·5	20·6	24·6	33·4
Alcohols . .	54	59	51	54	52	57
Methyl anthranilate	2·4	1·5	13·2	12·4	3·5	2·7

The lower yield of oil in the autumn blossoms is accounted for by a generally lower temperature and by the more active circulation of the constituents in the plant during the spring. The difference in the composition of the two oils is ascribed by Roure-Bertrand Fils to

[1] "Bull. Soc. Chim.," 3 (23), 605.
[2] "Bulletin" (April, 1910), 48.

[W.A.P.

FIG. 54.—Separating the Orange Flowers from the Leaves at the Chiris Works, Boufarik, Algeria.

the fact that in spring the young shoots determine the constituents while in autumn the maturer branches function in this manner. The low methyl anthranilate content is unexplained, since it is usually 7 per cent, but may be accounted for by the very severe winter which preceded these experiments.

Although, as stated above, the blossoms may be treated by different methods for the extraction of their odoriferous constituents, that of distillation is most common and represents approximately 80 per cent of the annual crop of flowers. The following figures are the approximate average yield per 1000 kilogrammes of fresh orange blossom :—

1. Distillation . .	from 900 to 1100 grams of oil.
2. Volatile solvents[1] .	,, 550 ,, 600 ,, ,, ,,
3. Maceration . . .	,, 350 ,, 450 ,, ,, ,,
4. Enfleurage	about 100 ,, ,, ,,

Distillation has always been the principal process, but at one time it was applied for the *Orange Flower Water* rather than for the oil, which was not much valued, and looked upon as a comparatively insignificant by-product. As we all know to-day, things are very different and the oil fetches high prices. The aqueous distillate is, however, a much esteemed article of commerce, and its odour, like that of the *absolute*, approximates more nearly to the fresh blossom than does the oil. Immediately after distillation this is a pale yellowish liquid, which gradually darkens with age until it becomes quite red, especially if exposed to strong light for a lengthy period. Under these conditions the odour of the oil is impaired, and if its delightful fragrance is to be retained, it should be stored in airtight containers in a dark and cool atmosphere. There are a number of grades of neroli oil offered by all the Grasse houses, and while some of the differences in odour may be accounted for by the methods and time of distillation, yet in the lower grades the odour bears a distinct suggestion of the blending in of finest French petitgrain oil. In the course of distillation the water

[1] The yield of absolute is about 1000 grams.

vapour undoubtedly acts upon the constituents of the oil, particularly upon the unstable terpenes. The esters also become partially saponified and the aldehydes more or less polymerised. Fortunately the alcohols, which constitute the most important part of the oil, are not seriously effected. Neroli oil remains one of the most esteemed raw materials of the perfumer.

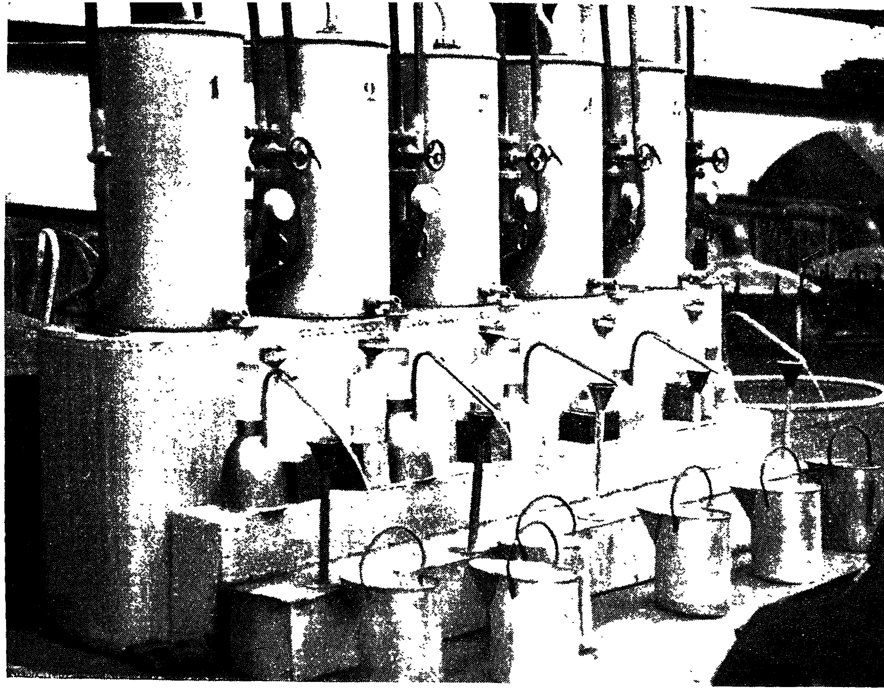
An essential oil is extracted from Orange Flower Water by means of acetone, petroleum ether, or ether, the yield being one kilo from about 3000 kilos of the water. It has a powerful odour, some ten times the strength of the normal oil, and owing to its solubility in water is useful for the extemporaneous production of Eau de Fleur d'Oranger.

Chemistry.—The composition of neroli oil has been known since 1895, but the first complete analysis was not published until 1902, when the announcement was made by Hesse and Zeitchel in the "Journal fur Praktische Chemie."[1] So far, the following constituents have been identified :—

Terpenes, chiefly dipentene, pinene, and camphene	35 per cent.
l-Linalol	30 " "
Geraniol and nerol	4 " "
Phenylethyl alcohol (found in the oil from the aqueous distillate)	traces
d-Terpineol	2 per cent.
d-Nerolidol	6 " "
Decylic aldehyde	traces
l-Linalyl acetate	7 per cent.
Neryl and geranyl acetates	4 " "
Esters of phenylacetic acid and benzoic acid	traces
Indole	up to 0·1 per cent.
Methyl anthranilate	0·6 per cent.
Jasmone, farnesol, acetic and palmitic acids	traces

The characteristic odour of the oil is primarily due to methyl anthranilate (and possibly jasmone), although such a

[1] Through Gildemeister and Hoffmann, "Volatile Oils," III., 97.



[*W.A.P.*

FIG. 55.—Separating Algerian Neroli Oil and Orange Flower Water at Boufarik.

[*To face page* 192.

small quantity is present, but there appears to be very little doubt that it is also influenced by both indole and aldehyde C_{10}. The odour of some oils would suggest that geranyl formate might be a possible constituent, but so far there appears to be no analytical evidence in support of this.

Orange Flower Water is a product of considerable commercial importance and in the majority of works is obtained as a by-product during the production of the oil. There are a number of distilleries, however, which attribute more importance to this product and these are situated at Le Cannet, Golfe-Juan, and Vallauris. Orange flower water of several strengths are recognised :—

1. *L'eau* 2 *kilos*.—1000 kg. of blossoms are distilled with a similar quantity of water and the first 500 litres collected.
2. *L'eau* 1 *kilo*.—1000 kg. of flowers are distilled with 1500 litres of water and the first 1000 litres reserved. This is known as Eau quadruple or K.P.K.
3. *L'eau double* is a mixture in equal proportions of distilled water and No. 2. It is known also as L'eau codex.
4. *L'eau simple* is an equal dilution of No. 3.
5. *L'eau triple* comes between Nos. 2 and 3 and is often known as L'eau superieure.
6. *L'eau de brouts* is produced during the manufacture of oil of petitgrain during the summer months.

During recent years the sophistication of these several grades of waters has become a serious matter and has led to an investigation by M. Bonis,[1] who outlined certain methods of standardisation. More recently this matter has been studied by Tomborel Freres,[2] who for the purposes of this investigation divided the water obtained in the course of distillation into two parts. For 100 kg. of flowers they separated the first 80 litres from the last 20 in order that the weight of oil in the fractions might be assessed as distillation proceeded. The first 80 litres gave an average of 0·031 per cent of oil, whereas the last 20 litres gave an

[1] "Perfumery and Essential Oil Record" (1924), 290.
[2] "P. and E.O.R." (1938), 206.

average of 0·008 per cent only. A mixture of these portions corresponding to K.P.K. gave an average of 0·027 per cent of oil. These figures were confirmed by an examination of authenticated water from other sources. It should be noted that with age the per cent of oil decreases.

Orange flower water assumes a greenish coloration with age and when exposed to strong light. According to Guyot[1] this is due to an aerobic microbe.

Petitgrain Oil is referred to as far back as 1694 by Pomet;[2] at that time it was distilled from the small unripe fruits about the size of a cherry which fall from the trees shortly after the flowers; they are called "orangettes," and the origin of the name is attributed to these small seeds or kernels. Pomet says they were infused in water for 5 or 6 days before distillation. The orange trees are pruned about the end of June, and from these prunings are separated the leaves and twigs which on distillation yield the petitgrain oil of to-day. The finest oils are obtained from the bitter orange trees of France, although other oils are distilled in Tunis and Paraguay. The sweet orange, the lemon, and the mandarin also yield petitgrain oils of distinct type which are useful in perfumery, but in odour they do not approach neroli oil so nearly as the first-mentioned product.

Compounding Notes.—Many of the finest neroli oil imitations are nothing more nor less than terpeneless petitgrain oil to which has been added in some cases neroli and aldehyde C_{10}: such products may be compounded as follows:—

Neroli, No. 1080.

800	Petitgrain oil—French, terpeneless.
100	Nerol.
10	Aldehyde C_{10}, 10 per cent.
90	Neroli oil.
1000	

[1] Schimmel's "Report" (1916), 39

[2] "Histoire des Drogues," p. 151.

Even when preparing the cheaper synthetic nerolis, French petitgrain is almost invariably used as the base, and in the cheapest of all products Paraguay petitgrain. These oils are blended with phenylethyl alcohol, nerol, linalol, and geraniol, and strengthened with sweet orange and methyl anthranilate. Important modifiers are geranyl and rhodinyl formates, benzyl acetate, terpineol, and ylang-ylang. Hydroxy-citronellal is often used in this capacity also. The very finest compounds almost invariably contain some genuine neroli oil and this constituent generally determines the selling price, according to the percentage used. Fixation is confined to the crystalline beta-naphthyl ethers, methyl naphthyl ketone and to indole. The gum resins are of course used in the cheapest nerolis but their odour is generally a deterrent. Decyl and amyl cinnamic aldehydes hold the field in the more powerful constituents.

The condensation product of methyl anthranilate and hydroxy-citronellal, known as aurantiol, is also a most valuable asset in all type of orange flower products.

Synthetic Components :—

Bases.—Petitgrain oil, French, Paraguay, and terpeneless.

Blenders.—Linalol, phenylethyl alcohol, nerol, geraniol, benzyl phenylacetate, phenyl acetaldehyde dimethylacetal, sweet orange, methyl anthranilate, cedrat, iso-butyl benzoate.

Modifiers.—Geranyl and rhodinyl formates, terpineol, hydroxy-citronellal, benzyl acetate, linalyl acetate, ylang-ylang, bergamot, iso-eugenol, methyl methyl anthranilate, nonyl acetate, decyl formate.

Fixers.—Methyl naphthyl ketone, beta-naphthyl ethyl ether, musk ketone, phenylacetic acid, phenyl naphthyl ketone.

Florales.—Neroli, orange blossom, jasmin, tuberose.

Aldehydes.—C_{10}, amyl cinnamic (now preferred to indole), phenyl propyl.

Formulæ indicating the use of these bodies are appended :—

Neroli, No. 1081.

200	French petitgrain oil.
200	Linalol.
100	Phenylethyl alcohol.
50	Nerol.
40	Phenyl acetaldehyde dimethylacetal.
80	Cedrat oil.
10	Ylang-ylang oil—Manilla.
50	Neroli oil.
50	Hydroxy-citronellal.
70	Ethyl anthranilate.
30	Geranyl formate.
10	Amyl cinnamic aldehyde.
10	Aldehyde C_{10}, 10 per cent solution.
50	Methyl naphthyl ketone.
50	Musk ketone.
1000	

Orange Blossom, No. 1082.

100	Linalol.
200	Phenylethyl alcohol.
50	Nerol.
50	Methyl anthranilate.
200	Petitgrain—para, terpeneless.
70	Linalyl acetate.
40	Aurantiol.
20	Linalyl benzoate.
50	Geraniol.
30	Terpineol.
50	Benzyl acetate.
20	Orange absolute.
	Geranyl formate.
10	Neryl acetate.
10	Decyl aldehyde, 10 per cent.
20	Amyl cinnamic aldehyde.
10	Ylang oil—Bourbon.
10	Phenylacetic acid.
10	Musk ketone.
50	Methyl naphthyl ketone.
1000	

Neroli, No. 1083. (Cheap.)

500	Limonene.
150	Geraniol.
20	Geranyl formate.
100	Linalol.
100	Methyl anthranilate.
10	Amyl cinnamic aldehyde.
50	Bergamot oil.
60	Tolu balsam.
10	Beta naphthol ethyl ether.
1000	

ORCHIDS.

History.—The *orchis* is referred to in a few places in classical literature. Theophrastus mentions it, while Pliny discusses at length the medicinal properties of some five different varieties. In Book XXVI, chapter 62, this writer says there are few plants of so marvellous a nature as the orchis, a vegetable production . . . having a twofold root formed of tuberosities which resemble the testes in appearance. The larger of these tuberosities, or as some say, the harder of the two, taken in water is provocative of lust; while the smaller, or, in other words, the softer one, taken in goat's milk, acts as an antaphrodisiac. Some commentators are of the opinion that these properties have not been proved, but Linnæus, however, seems to think that the orchis may have the effect of an aphrodisiac upon cattle. It is the name, no doubt, signifying "testicle," which originally procured for it the repute of being an aphrodisiac.[1]

The Plant.—*Orchis* is the name of a Linnæan genus and the type of an extensive family of plants termed *Orchidaceæ*, generally referred to as orchids. The number of known species exceeds 6000, and they take the form of shrubs or herbaceous perennials, all of which are particularly handsome and deservedly popular. They are found

[1] Consult also Pliny, Bk. XXVII, chap. 42, where a more detailed account of these properties is discussed.

in tropical and temperate countries; a large number grow on trees, some grow on rocks, and many have tuberous roots growing in the ground, of which over forty are natives of this country. Although the species are numerous, the only one of economic importance to the chemist-perfumer is *vanilla*. In Asia, a farinaceous meal is obtained from the tubers of several terrestrial orchids. This is known as *Salep*, and in Northern India it is largely used as food by the natives. In this very large group of plants, there is an unusually wide range of floral variations, those of form and colour being particularly noticeable. The flowers also exhale a variety of odours, ranging from the most exquisite fragrance to the most disagreeable putrescence. During recent years orchids have become highly patronised as peculiar and attractive garden plants, and to obtain them plant collectors have gone to the most remote regions of both hemispheres; they have thus become important trade plants. High prices have been obtained for rare varieties, and in 1881 an amateur collection realised over £5000, some individual plants being sold for as much as £100 or even more.

Odour Varieties.—According to Donald McDonald[1] a series of observations on the odours of orchids was conducted by E. Andre, an eminent French botanist, and among the varieties exhibiting peculiar scented attractions are the following:—

Acropera Loddigesii, the dainty scent of wallflowers.

Angræcum fatuosum, a sweet odour of tuberoses.

Bifrenaria inodora, like muguet.

Catasetum scurra, the aroma of lemons.

Cattleya Eldorado, an odour of roses in the evening only.

Cœliopsis hyacinthesma, the perfume of hyacinths.

Cleistoma ionasmum, violet-scented.

Dendrobium glumaceum, lilac in the evening, and heliotrope in the morning.

[1] "Fragrant Flowers and Leaves" (1895), 86.

Dendrobium nobile, odour of hay in the evening, honey at noon, and primrose in the morning.

Epidendrum vulnerum, an odour of carnations in the morning.

Maxillaria aromatica, cinnamon-scented.

Odontoglossum citrosum, rose-scented.

Odontoglossum gloriosum, like a whole hedge of hawthorn.

Orchis Sambucina, the odour of elder flowers.

Zygopetalum Mackayi, hyacinth-scented during sunshine.

Two other odorous species are worthy of note:—

Herminium monorchis, known also as the musk orchid, grows to a height of 4 inches, and during June and July bears attractive pale green flowers. Odour, musk-honey.

Habœnaria conopsea, known also as the sweet-scented orchid, grows to a height of 4 to 8 inches, bears mauve flowers and has the perfume of hyacinths.

In China one of the most highly esteemed flowers belongs to the orchid family. This is *Cymbidium ensifolium*, and it exhales a very intense and sweet fragrance. Its cultivation requires considerable care—a very even temperature (about 15° C.) and rain water only for watering.

Chemistry.—From the point of view of the perfumer the most important orchid is vanilla, the cultivation, curing, and chemistry of which has already been discussed in Volume I and elsewhere.[1] The most important constituent is vanillin together with anisic aldehyde, anisic acid, and alcohol. As far back as 1901, however, Crouzel[2] extracted *orchis militaris L.* with ether or alcohol and obtained a small amount of oil, yellowish in colour and of a pleasant strong odour. The oil could not be obtained by steam distillation.

Compounding Notes.—Iso-butyl salicylate is the most useful base for all orchid perfumes, but when it is not available very good results are obtained by substituting amyl salicylate, although the note is not so floral. The odour

[1] "American Perfumer" (1928), 69.
[2] "Apotheker Ztg.," 16 (1901), 6.

of both these bases is suitably modified by additions of rhodinol, nerol, and linalol. The blend is perfected according to individual tastes, and providing the laws of harmony are adhered to any of the flower modifications enumerated above may be employed. Of the fixatives, oakmoss is the most useful, and it can be supplemented by additions of ylang-ylang, benzoin, or Peru balsam, according to the type of odour being imitated. Phenylacetic acid is another valuable fixator, as are also the musks, vanillin, and coumarin.

Synthetic Components:—

Bases.—Amyl and iso-butyl salicylates.

Blenders.—Linalol, rhodinol, geraniol, nerol, phenylethyl alcohol, phenylethyl propionate and formate, benzyl acetate.

Modifiers.—Ylang-ylang, hydroxy-citronellal, α-ionone, methyl ionone, phenylacetic aldehyde, benzaldehyde, anisic aldehyde, iso-eugenol, esters of cinnamic alcohol, heliotropin.

Fixers.—Oakmoss, benzoin, vanillin, coumarin, musk ambrette, phenylacetic acid, Peru balsam, castoreum.

Florales.—Jasmin, neroli, tuberose, orange blossom, rose.

Aldehydes.—Methyl nonyl acetic, phenyl propyl, C_9. C_{10}, C_{12}.

Formulæ follow :—

Orchid, No. 1084.

400	Iso-butyl salicylate.
100	Linalol.
100	Rhodinol.
75	Phenylethyl alcohol.
75	Nerol.
5	Methyl nonyl acetic aldehyde, 10 per cent solution.
50	Phenylacetic aldehyde.
50	Hydroxy-citronellal.
5	Oakmoss resin.
40	Ylang-ylang oil—Manila.
50	Benzoin R.
10	Musk ambrette.
40	Coumarin.
1000	

Orchid, No. 1085.

500	Amyl salicylate.
200	Anisic aldehyde.
100	Geraniol.
50	Acetophenone.
50	Bois de rose oil.
2	Benzaldehyde.
50	Balsam Peru.
3	Aldehyde C_9.
10	Dimethyl hydroquinone.
35	Heliotropin.
1000	

Alcoholic Perfumes, like the ottos, are not much in demand, and different makes are subject to wide variation. An example of the violet type follows :—

No. 1086.

60	Orchid, No. 1084.
3	Jasmin absolute.
2	Orange blossom absolute
5	Cassie absolute.
10	Methyl ionone.
8	Heliotropin.
2	Anisic alcohol.
10	Musk extract, 3 per cent.
900	Alcohol.
1000	

RESEDA.

History.—Mignonette is a native of Egypt and the shores of the Mediterranean. The plant was known to Pliny, and in those days the Romans used it as a charm to allay the irritation of wounds, disperse abscesses and all kinds of inflammation. The origin of the name *Reseda* may even be connected with its clinical value and is said to be derived from the Latin *Resedo*, to heal. According to Pliny the plant grew near the city of Ariminum (now

Rimini) in Italy. At an early date it was introduced to the south of France, where it received the name of mignonette, signifying in French "little darling." It made its appearance in Britain about 1750, and two years later is stated to have been cultivated in the Apothecaries' Botanic Gardens, Chelsea. Since then it has been a great favourite, and in this country is an annual, while in the south of Europe it becomes shrubby.

Varieties.—*Reseda odorata* is the type of the N.O. Resedaceæ, consisting of over twenty species. The flowers were originally greyish-white with red stamens, but have since given place to fine white, red, and yellow-flowered varieties.

R. odorata has greenish-yellow or white flowers, highly odoriferous, more or less common in British gardens. This is the species cultivated in the south of France. There are several varieties of this species, the most important being the compact, strong-growing *Machet*. The flowers are reddish. This is much grown in pots for the London markets.

R. luteola is a smaller plant having greenish-yellow flowers. It grows wild on waste chalky soil. This species is known in France as "Gaude" and *Reseda sauvage*. It is of no value as a raw material in the perfume industry, but is occasionally employed (and cultivated) as a yellow colouring material. In Britain this species is known as Dyer's Rochet and yellow weed.

R. lutea is a similar but less significant species.

R. alba is like *R. lutea*, but has whiter flowers.

Jamaica mignonette is a pseudonym applied in the West Indies to Henna flowers (*Lawsonia Inermis*). Their fragrance is more suggestive of mignonette combined with rose.

Odour.—The perfume of the common mignonette grown in this country is poor compared to the very fine fragrance obtained by careful cultivation in the south of France. The odour recalls that of violet leaves and basil.

Fig. 56.—Plantations of Mignonette at Abadie.

[*A. Chiris.*

[*To face page* 202.

Natural Perfume.—In the south of France (Grasse, La Roquette, Mandelieu, and Pégomas districts) reseda is grown for its perfume, which is extracted principally by volatile solvents and to some extent by maceration and enfleurage. The plant is delicate and the crops often fail in consequence of late winds. During recent years the demand for this flower by the factories at Grasse has noticeably declined, and since growers do not plant unless they are sure of selling the crop, its cultivation has diminished. It is usual for the growers to ascertain the requirements of the works during February, and plant accordingly, the crop occupying the ground only for five months from March to July. Mignonette requires not only a rich, fertile, clean soil with plenty of sun and irrigation, but it also needs ample manure and labour. There is always a risk of irregular yields. The flowers gathered in March and April produce the finest perfume, and in a good year the total crop will reach about 20,000 kilos. In the last two or three years this has dropped to about one-fifth the figure, and the flowers have averaged 7·50 francs per kilo at the works. About 1200 kilos of flowers yield 1 kilo of concrete which gives some 350 grams of absolute. This is not very largely employed, but when violet crops are poor the demand for it is generally increased.

Chemistry.—As far back as 1893 this plant drew the attention of research workers, and Schimmel & Co. were able to isolate about 0·002 per cent of volatile oil. This was a semi-solid substance having an intense floral odour. In 1895 Bertram and Walbaum[1] distilled the root of this plant and obtained an essential oil having an odour recalling radishes. The principal constituent proved to be phenylethyl thiocarbamide.

Mignonette perfume was for some years ingeniously marketed by Schimmel & Co. who distilled with every 500 kilos of blossoms 1 kilo of geraniol. This substance was

[1] "Year Book of Pharmacy" (1895), 122.

called **Reseda Geraniol** and made a good base for the flower perfume.

Compounding Notes.—There are few synthetic aromatic chemicals with odours resembling reseda, and the majority of imitations really contain fairly large proportions of the natural absolute. Ethyl decine carbonate probably bears the closest resemblance, and is used up to about 5 per cent of the total. This material can be backed up with methyl ionone, when a fairly good base results. Another body having a distinct reseda-like odour is hexyl-methyl ketone, and providing it is blended with one of the violet ketones, will make a useful base. Basil oil is indispensable to obtain the true basic note and is very powerful. About 5 per cent will be about the maximum necessary. Blenders offer a wide selection and include, phenyl acetaldehyde dimethyl acetal, clary sage, bois de rose, petitgrain, bergamot, lavender, cedarwood, clove, and santal. The floral note is obtained by the employment of natural jasmin and cassie in addition to reseda absolute, while the odour may be modified by including traces of aldehyde C_{12}. The synthetic compounds are best fixed with oleo-resin orris and labdanum, but variations may be made with musk ambrette, kostus, or galbanum.

Synthetic Components :—

Bases.—Basil oil, ethyl decine carbonate, hexyl methyl ketone, methyl ionone, iso-propyl benzyl carbinol.

Blenders.—Orris, bergamot, linalol, lavender, petitgrain, bois de rose, cedarwood, santal, benzyl acetate, duodecyl alcohol, geraniol, phenyl propyl alcohol, phenyl acetaldehyde dimethyl acetal, heliotropin.

Modifiers.—Cummin oil, ylang-ylang oil, clove, iso-eugenol, cinnamyl butyrate, methyl octine carbonate, iso-butyl salicylate, anisic aldehyde.

Fixers.—Musk ambrette, costus, labdanum, orris, oleo-resin, styrax, clary sage, galbanum.

Florales.—Reseda, cassie, jasmin, violet leaves.
Aldehydes.—C_{12}.

Formulæ follow :—

Reseda, No. 1087.

50	Ethyl decine carbonate.
200	Methyl ionone.
250	Reseda geraniol.
50	Cassie, No. 1025.
100	Jasmin, No. 1053.
15	Orris oleo-resin.
4	Labdanum R.
50	Reseda absolute.
20	Duodecyl alcohol.
1	Clary sage oil.
40	Basil oil.
120	Bergamot oil.
70	Linalol.
20	Iso-butyl salicylate
10	Heliotropin.
1000	

Reseda, No. 1088.

300	Methyl ionone.
50	Hexyl methyl ketone.
10	Violet leaves absolute.
10	Methyl heptine carbonate.
20	Aldehyde C_{12} (laurinic), 10 per cent.
50	Benzyl acetate
160	Bergamot oil.
10	Lavender oil.
70	Petitgrain oil.
10	Basil oil.
100	Santalwood oil.
10	Galbanum R.
100	Phenyl propyl alcohol.
30	Ylang-ylang oil—Bourbon.
10	Musk ambrette.
20	Reseda absolute.
40	Orris oil concrete.
1000	

Alcoholic Perfumes may be made from the compounds given above. A formula is appended :—

No. 1089.

80	Reseda, No. 1087.
3	Musk extract, 3 per cent.
7	Civet ,, ,,
2	Tuberose absolute.
8	Jasmin ,,
900	Alcohol, 90 per cent.

ROSE.

History.—The charm and delightful fragrance of the rose is known and appreciated the world over to-day. Since earliest antiquity these qualities have led to its being regarded as the queen of flowers, and ancient literature contains many references to it.

It is doubtful whether several of these references are to the rose as we know it to-day, and this is well illustrated by one of the earliest mentions which occur in the Scriptures. In 713 B.C. it was written,[1] "The desert shall rejoice, and blossom as the rose." In this verse the Hebrew word has been translated rose while the same word has also been translated (300 years later) Rose of Sharon.[2] According to John Smith, one of the ablest commentators, it is very improbable that both plants are roses. Certain roses grow wild on Lebanon and in other parts of Palestine, the most prolific being the Dog Rose, *Rosa canina.* The other references[3] to roses in the Apocrypha may, according to Smith, be any of the following: *Cistus ladaniferus*, *Hibiscus Syriacus*, or *Nerium Oleander.*

Mythological writers found ample scope in endeavouring to account for the creation of the rose. One

[1] Isa. xxxv. 1.
[2] Consult also Narcissus.
[3] 2 Esdras ii. 19; Wisdom ii. 8; Eccles. xxiv. 14.

FIG. 57.—The Village of Shipka in the Kazanlik Valley.

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of the oldest stories is that Flora found the corpse of a beautiful nymph, a daughter of the Dryads, and with the assistance of Venus and the Graces transformed it into this beautiful flower. The ceremony was attended by the Zephyrs who cleared the atmosphere so that Apollo might bless the new flower with his beams. Bacchus supplied the nectar and Vertumnus the perfume. Pomona strewed her fruit over the young branches, which were then crowned by Flora with a diadem especially prepared by the Celestials to distinguish this most beautiful blossom.

The perfume of roses was first extracted by placing the petals in oils and fats. They were then used as unguents, and Homer states that Aphrodite anointed the dead body of Hector with such a product.

Theophrastus tells us that the rose perfume was best absorbed by sesame oil because of its viscid nature. He also says that the rose imparts a fragrant scent or sweet taste to wines. There appears to have been some superstition associated with the collection of the fruits of wild roses, for we read in his, "Enquiry into Plants," that if they were not gathered while standing to windward there was a danger to the eyes. Pliny describes the luxury in which the Romans lived, and says that their food was either covered with rose petals or sprinkled with rose perfume. In Book XXI, chapter 10, there is a discourse on several varieties of roses, and here Pliny remarks that flowers having 100 or more petals are known as *centifolia*. He further states, and quite erroneously, that the best proof of the perfume of the rose is the comparative roughness of the calyx. The most odoriferous of all roses, Pliny continues, comes from Cyrenæ,[1] and is the most esteemed for use in unguents. When the juice had been extracted from the petals they were dried and powdered. This particular *diapasmata* was sprinkled on the body to check perspiration.

Many considered the flower emblematic of joy while others regarded it as a symbol of silence. At feasts, where the conversation was to be held secret, it was customary to

[1] According to Fée, *Rosa Damascena*.

suspend a rose over the table. Hence the saying "*Sub-Rosa.*"

In Egypt the rose was equally popular, for we are told that men of rank had their mattresses filled with rose petals. Cleopatra was noted for her luxurious habits, and it is recorded that at one of the feasts she gave to Anthony, the royal apartments were covered with perfumed rose leaves to a considerable depth.

Roses evidently played an important part in the magic of ancient antiquity, for we learn on reading the metamorphoses (The Golden Ass) of the Roman jester, Lucius Apuleius, that while journeying through Northern Africa he committed some trifling indiscretion, and because of this was turned into an ass by a witch. The only way he could regain his human form was by *eating* roses.

The distillation of roses probably originated in Persia at a very remote period, which may quite conceivably ante-date the Christian era. According to a document in the National Library of Paris the province of Faristan was required to pay an annual tribute of 30,000 bottles of rose water to the Treasury of Bagdad as far back as A.D. 810. Faristan seems to have been the principal centre for the production of this commodity, for it is also stated that considerable quantities were from thence sent to India, China, Yemen, Egypt, etc. The most important factories appear to have been situated at Firazabad, between Shiraz and the coast. The art of distillation was probably introduced into western countries by the Arabs in the tenth century, and the first country in Europe to employ it would seem to have been Spain.

It is a curious thing that no mention is made of rose otto until 1574 when small drops of it were found floating on the surface of rose water by Geronimo Rossi at Ravenna. Its discovery by the Persians (1612) is associated with one of the Grand Moguls who filled the canals in his gardens with rose water. One of the Princesses noticed a scum floating on the surface which she caused to be collected. This was found to be intensely odorous and was highly treasured by her. The production of rose otto (*Aettr Gyl*) at Shiraz dates from this period.

About the seventeenth century rose cultivation spread from Persia to India, Northern Africa, and Turkey, and in the year 1710 was established for the first time in Bulgaria, close to the village of Shipka (at the foot of the famous pass) in the Kazanlik valley. The Damask Rose plants were brought from Asia Minor and their cultivation thrived so well that in 30 years it extended to the whole valleys of Karlovo and Kazanlik. By 1750 Bulgaria had become the principal source of supply of the present rose otto.

In more recent years the plant was cultivated in England, France, and Germany, but the commercial distillation of the oil was not begun in France until the end of the nineteenth century. Previously the flowers had been grown for sale, and in some cases were used for the production of fragrant rose water. The large quantities of blossoms which were then wasted are now, as above stated, turned to some commercial account.

Since its first production, attar of roses has been much esteemed as a perfume, and up to a few years ago the demand was generally greater than the supply. In consequence sophistication was much practised both by manufacturers and dealers, and among the articles used for this purpose were palmarosa and ginger-grass oils and spermaceti. Nowadays the decreased demand for rose otto, the keen competition for quality amongst distillers, and a greater knowledge and experience amongst buyers, has led to the sale of oils of exquisite quality. Naturally these are more costly, and buyers who insist on forcing down the price will still get oils analysing as "pure" but which would never be acceptable to an experienced nose.

Flower Varieties.—According to ancient mythology the rose was originally white in colour, and the red varieties were created when a rose-thorn pierced the foot of Venus, the blood escaping from the wound being supposed to have dyed the petals! At the time of Theophrastus it is certain that *some* different varieties existed, for he describes many physical differences and refers to the perfume. Pliny also distinguished them one from another by similar comparisons. Nowadays, on referring to horticultural catalogues, we find thousands of varieties of roses listed under as many different names. It appears probable that a large number of these are the fancy of the florist and have no scientific botanical classification, in some cases a grower having given another name to a hybrid which had previously been discovered by some one else.

Over two hundred species have been named, but it is doubtful if more than one-sixth of this number are specifically distinct. Of the roses which are natives of these islands about twenty are said to belong to England, four to Scotland, one to Ireland, and one to the Scilly Isles. According to the "Hortus Kewensis," these are made to form seven distinct species, the most delightful wild rose being the sweetbriar or eglantine, *Rosa rubiginosa* or *R. eglantina*, whose fragrance is especially charming after a shower of rain.

The characteristic rose perfume is well developed in the following species:—

Rosa centifolia, *L.*, large pinkish or purplish-red flowers, fragrant, cultivated in British gardens and known as "cabbage" rose. The "Rose de Mai" of the French perfumer. Single flowered varieties grow wild in the Eastern Caucasus.

Rosa Damascena, Mill., large red (and occasionally white) flowers, cultivated in Bulgaria. *Rose de L'Hay*, having large pinkish-white flowers and experimented with by French perfumers, is a cross between *R. Damascena*, *R. Jacqueminot*, and *R. rugosa*.

Rosa alba, *L.*, flowers generally white but sometimes pale pink.

Rosa Gallica, *L.*, crimson or deep red petals. In Britain a variety of this species is known as the "Damask" rose.

FIG. 58.—Collecting Roses in Bulgaria.

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The "Province" rose of France is also a variety of *R. Gallica*.

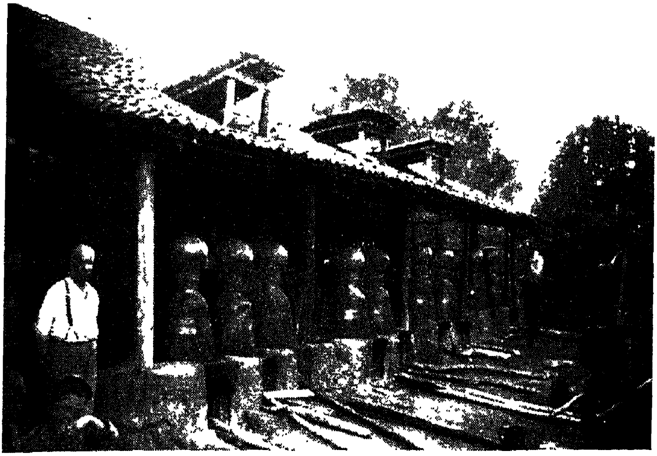
Odour.—Slight differentiations in odour value are not perceptible to every one. The sense of taste is, however, generally more developed, and inconsiderable modifications of flavour are more frequently noticed. To the trained specialist, however, the merest graduation of odour is appreciable, and an expert florist will name the variety of rose *even in the dark*. The real rose odour is unique, and represents a *type* which is undefinable, incomparable, and at present inimitable by synthesis. This type is best represented by *Rosa Damascena*, cultivated in Bulgaria, and approximated to very closely by *Rosa centifolia*, cultivated in Provence. There are many variations from this type, and some of the roses which exhibit slightly different floral notes are enumerated below; they represent practically all those that the perfumer is required to imitate:—

R. arvensis, also known as the Ayrshire rose—some varieties are myrrh-scented; *Banksian*, recalling violets; *Canina*, resembling mignonette; *Desprez*, fruity; *Eglantine*, whose leaves recall jasmin; *Macartnean*, apricots; *Marechal Niel*, the most delightful of the "tea" class, having a somewhat fruity odour, resembling raspberry; *Moschata*, growing wild in Tunis and believed by some to be musky and by others to resemble pinks; *Muscosa*, moss-scented; *May*, recalling cinnamon; *Safrano*, recalling pinks; *Socrates*, resembling the peach; *Souveraine*, the melon; *Unique jaune*, the most charming of the "noisette" type and having an odour of hyacinths. During 1929 a new rose, known as "Portadown Fragrance," made its appearance. It is alleged to have taken eleven years to "produce" and is the result of ingenious crossing by Samuel McGreedy & Sons. According to report the odour is a complex of tea rose and verbena. In the majority of cases red roses are more odoriferous than white ones, but a peculiarity possessed by a number of both kinds is that, when cut and placed in water, their fragrance appears more pronounced than when growing. Roses cultivated in a hot climate have a more powerful perfume, and it has been noticed that those flowers grown under glass develop a finer aroma than those which thrive in the open air. Some roses, *e.g.* *R. gallica*, develop their perfume when dried, while others, *e.g.* *R. Damascena*, lose it under similar circumstances. Sawer states [1] that before a storm the odour of a rose *seems* strangely increased, and suggests that this may be due to the oxidising influence of the ozone in the atmosphere or to the perceptive faculties being sharpened at such moments. Other peculiarities of the rose odour are (*a*) that no two flowers emit the same fragrance; (*b*) that different flowers from the *same* plant have never *exactly* the same perfume.

Natural Perfume.—The finest and most powerful form in which the rose perfume can be obtained is undoubtedly the *otto*, which is a product of distillation. Unfortunately, however, owing to the loss of phenylethyl alcohol, a large proportion of which remains dissolved in the rose water, the otto does not accurately represent the flower odour. This is more nearly approximated to by the "absolute" obtained by means of volatile solvents, which method is largely employed in the south of France and to some extent also in Bulgaria. There is a slight difference in the odour of these two absolutes, and a good deal of that produced in Bulgaria finds its way to Grasse. The perfume may be extracted in the form of pomade by maceration, and in a very few instances where rose water is produced in Grasse, the oil is separated which contains the most highly odorous constituents and all the stearoptene. This is the highest priced otto obtainable.

Bulgarian Rose Otto.—Constitutes the bulk of the world's production of this volatile oil. The flowers are cultivated in the famous Valley of Roses. This is situated about 200 kilometres east of Sofia, and extends along the southern slopes of the Balkans. It is accessible by road

[1] "Odorographia" (1892), 24.



[*W.A.P.*

Fig. 59.—Peasant Stills.

[*W.A.P.*

Fig. 60.—Peasant Distillery. (Note primitive sieve for removing flowers from residuary waters.)

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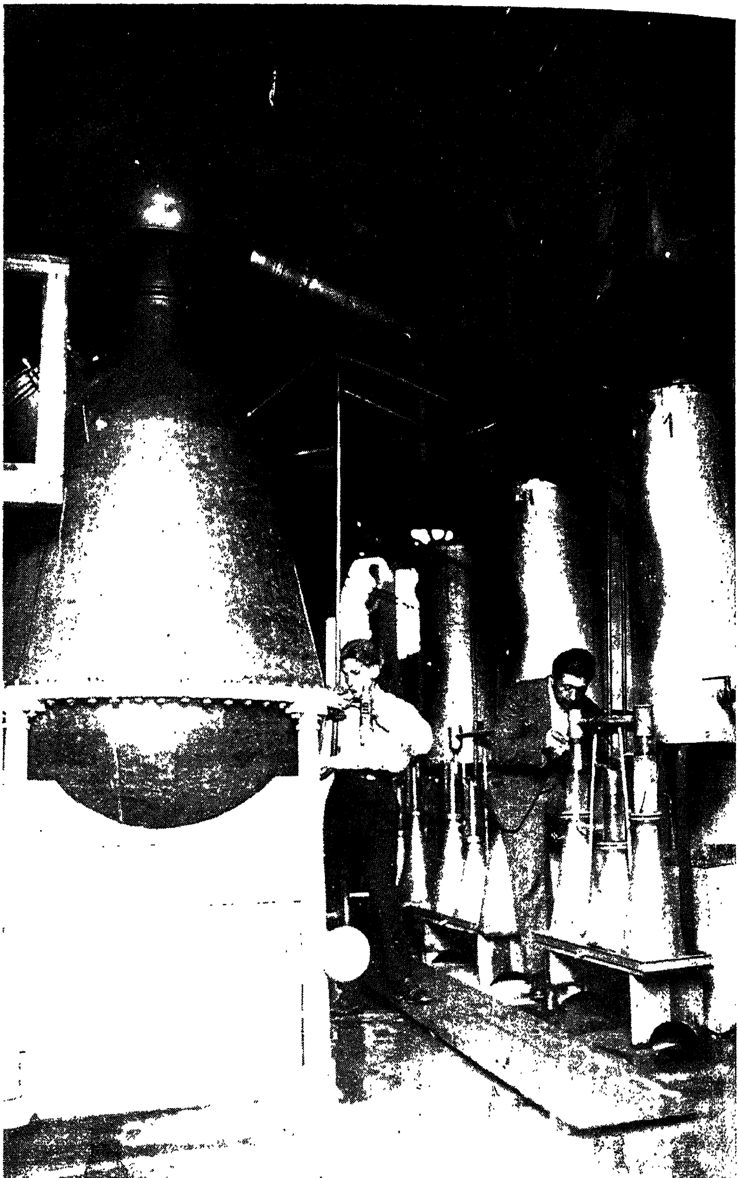

[*A. Chiris.*

FIG. 61.—Distillation of Rose Otto in Bulgaria.

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over the Klissoura Pass in six hours by motor car from Sofia, or from the latter city to Stara Zagora by rail in six hours, thence by road in two hours. The valley is about 160 kilometres long and varies in width from 5 to 30 kilometres. This includes ten districts, of which the most important are Kazanlik, Karlovo, Brezovo, Tchirpan, Nova Zagora and Stara Zagora. There are in fact two actual valleys—Toundja and Strema—with Kazanlik and Karlovo as their central towns. About 150 villages, with a population of over 200,000, are more or less engaged in the rose industry. They cultivate from four to nine thousand hectares of rose fields, yielding annually approximately eight million kilogrammes of flowers. The most highly productive districts are from 300 to 700 metres above sea level.

The rose trees flourish best in sandy or light stoney soil, since this does not so easily retain water like chalky soil and therefore reduces the danger of the young plants being destroyed by frosts during the winter months. The principal species cultivated is *Rosa Damascena*, Miller, and this accounts for nearly 90 per cent of the roses grown. It is not known in the wild state, but is a product of horticulture, the original plant being a hybrid between *R. Gallica* and *R. canina*, with the characteristics of the former predominating. The shrub attains a height of 4 to 6 feet and blossoms during the months of May and June. Six or seven blooms appear on each branch but in a good year there may be double this number. The perfume is most powerful when the flower opens. Both single and double varieties are grown. A small quantity of *R. alba*, L., is also cultivated because it thrives better on poorer soil, is more hardy and yields nearly 40 per cent more blossoms. As a rule it is used mainly for hedging the fields of pink roses. The perfume is not so fine, it yields less otto and in consequence is not so valuable. Both single and double varieties are cultivated, the former yielding a higher percentage of oil. Even this, however, is only about one-third the yield from *R. Damascena*. In addition to these two species, small quantities of *R. centifolia* and *R. Stamboletz* are cultivated. According to Blisnakoff[1] the properties of the latter approximate closely to those of *R. Damascena.*

The rose trees are grown either from roots taken from overgrown fields or from cuttings. They are planted out in rows, generally in the autumn and sometimes in the early spring. Those transplanted during November take root more easily. The ground is kept free from weeds, ploughed and manured systematically. No blooms appear in the first year, few in the second, more in the third, and a maximum between the fourth and tenth years. After about ten seasons the shrub becomes exhausted and is rejuvenated by the removal of its branches. New shoots appear in the following year and the crop is again good in the second year. Rose trees thus carefully treated are productive of blossoms for 20 or 30 years.

The harvest takes place during May and the early part of June, but this depends on atmospheric conditions and the place of collection. According as the weather is dry and hot or cool and rainy during the season, the harvest may last from 15 to 30 days. With the former conditions the time is shorter, the buds expand quickly and during the heat of the day lose some of their perfume with a diminishing yield of oil. Ideal conditions are gentle rain occasionally with a little sun.

The flowers are usually collected before they begin to open, and while covered with dew, a little in advance of sunrise. Those which are gathered later in the day emit a more powerful fragrance of less delicacy, and the resulting distillation product is not so sweet in consequence.

The blossoms are collected by young boys and girls and also by a number of old women. They place the flowers in small baskets and when full empty them into sacks, containing about 40 kilos. They are thus transported by means of bullock waggons and donkey carts to the distilleries, sometimes a distance of 50 kilometres, when they are unloaded in a cool and shady place and

[1] "P. and E.O.R." (1925), 292.

[W. A. P.

FIG. 62.—Roses arriving at Bontcheff's Distillery.

[W. A. P.

FIG. 63.—Bontcheff's Still Heads

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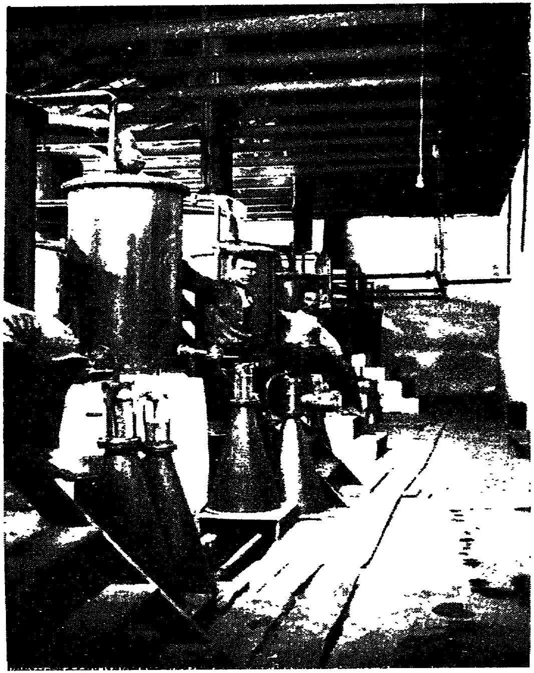

[W.A.P.
FIG. 64.—Bontcheff's Condensers.

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FIG. 65.—Christoff's Fire Stills.

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gradually distilled during the day and the following night. It is customary to sprinkle the sacks with water, to keep them cool, to prevent undue evaporation of the perfume, and incidentally to prevent fermentation. There are four different systems of extracting the perfume from the flowers, as follows :—

1. Open fire with small alembics.
2. Open fire with large alembics.
3. Steam stills including vacuum and rotary apparatus.
4. Volatile solvent extraction.

Distillation with Small Alembics.—Up to 1902 all the rose otto exported from Bulgaria was distilled by the growers themselves in small tinned-copper alembics. At that time there were in all 2800 distillers, operating over 13,000 small alembics having a total capacity of nearly fifteen million kilos of rose blossoms. Now there are only about 300 peasant distillers with under 2000 stills, the old system of distillation being continually replaced by modern methods, involving the use of large improved stills. There are at present over 50 new modern plants, operating some 400 large open-fire stills and 30 steam stills. These modern factories distil nearly 80 per cent of the entire rose crop, and the growers only 20 per cent of it. The latter generally use the old-fashioned *gulapana*, which constitutes one of the out-buildings of the local farmer. The small alembics are some 40 to 43 inches high and have a base of about 32 inches diameter. There are two handles, one on each side for lifting when charging and discharging. They are constructed as near as possible to a stream so that the supply of water for distillation and condensation is assured. The apparatus is comparatively crude and consists of a truncated cone copper boiler having a capacity of about 120 litres. The helmet top is mushroom shaped and has a straight condensing tube fitted into one side. This runs through a wooden vat containing the cooling water, and where it emerges below there is a cavity in the ground which acts as a receptacle for the glass receiver. The stills are generally placed in rows on a low brick hearth. Wood is used as fuel.

On arrival at the gulapana the red and white roses are mixed and distilled at once. During the busiest times it is often necessary to spread the roses out in a cool place to await distillation when they are moistened with cold water to prevent fermentation. Ten kilos of petals and 75 litres of water are placed in each boiler, the apparatus is fitted together and sealed. The fire is then lighted and it takes from 1½ to 2 hours for complete distillation. The yield of rose water and otto measures about 10 litres and this is placed aside. The apparatus is then emptied, the exhausted roses separated by strainer and the hot water returned to the boiler for the second distillation. This generally measures about 50 litres, and so another 25 litres of fresh water is added for the further charge of 10 kilos of rose blossoms. This process is repeated until the day's collection of flowers has been disposed of. The rose otto is separated from the reserved distillates by placing the products of four distillations (40 litres) together in the apparatus and carefully distilling the whole. The first 5 litres of cloudy distillate are reserved, and when this clears the otto is found floating on the surface. It is carefully removed and stored in glass flasks. The other 35 litres is left in the still and a fresh quantity of rose water added. The process is repeated and the otto separated.

As will be observed, the peasant-farmer generally re-employs the residuary water remaining after each operation, and this constitutes a fundamental difference between his process and that of the larger manufacturers, where the exhausted flowers *and residuary water* are discarded. In the former case, the hot and dark coloured residuary waters give the farmer the advantage that he commences his new distillation with already heated water and so saves fuel. It will be obvious that the progressive concentration of extractive matter in these residuary waters will raise the boiling-point and cause constituents to be carried over with the distillate which increases the yield of oil. Since, however, such residuary waters in time assume a sharp and distinctly unpleasant odour, the increased yield of oil is largely discounted by the fact that the quality is impaired. Nowadays many farmers have observed this disadvantage and, like the larger distillers, completely discard both exhausted blossoms and water together, thus dispensing with the use of sieve or strainer as the case may be. The rose oil made by this primitive method is known as *Peasant Quality* and possesses a soft, sweet, honeyed odour lacking in strength. It is cheaper than the oil distilled in the large alembics because, in the first place, the farmer does not "cost" his labour and that of his family, and in the second place the capital involved is comparatively insignificant. This type of oil successfully competes with ottos produced by other means of distillation.

Distillation with Large Alembics.—There are over 50 large distilleries belonging to private firms or to co-operatives. These contain some 400 large open-fire stills having a capacity varying from 500 to 2500 litres and are capable of distilling 100 to 500 kilos of roses at each operation. They are usually made of copper and may have either fixed or detachable heads. Different forms exist, some being the flat type of still and others the erect cylindrical apparatus. In all cases they differ from the small former type in that they are built into hearths so that no loss of heat occurs. Moreover, they have a perforated platform inside near the base to prevent the flowers coming into contact with the direct heat of the fires beneath. Worm condensers are almost invariably used, and the receivers resemble large florentine flasks having cylindrical glass tops for the observation of the oil as it collects on the surface. In the fixed-head type of still the flowers are charged through a manhole direct from the sacks and until the blossoms are within a foot of the top. Water is then run in until the flowers are completely covered.

A hefty worker stirs the whole mass with a long pole to ensure the separation of the blossoms so that they will float freely once the operation has commenced. (Coagulated groups of flowers would interfere with the complete removal of the essence.) In normal times the ratio of water to flowers is strictly observed, being 4 or 5 litres to 1 kilo of roses. The ratio is only decreased with pressure of work when the crop is exceptionally abundant. The charging orifice is closed and the fire lighted. Considerable experience is here necessary. The application of heat must be gentle, otherwise a too sudden rise in temperature would drive out some of the lighter perfume constituents with the air remaining in the still and would thus be lost to the detriment of the subsequent oil distillate. As a rule it takes one and a half hours before any condensation takes place, and from two to two and a half hours more to complete the distillation. The distillate passes through the condenser, which is comparatively hot at the top and not very cold at the bottom. The temperature of the distillate is kept at just over 35° C., otherwise the stearoptene would crystallise inside the condensing tubes. The distillation is not stopped until about 1 litre of rose water is collected for each kilo of flowers in the still, the actual volume depending upon pressure of work. The contents of the still, that is, exhausted flowers and water, are emptied from a side exit and pass down shoots into a river. The distillate flows from the condensers into the receivers, arranged in series of two for each still, and the rose water constantly passes from the second into open tanks having a capacity of 100 to 150 litres. When full, the contents are automatically pumped into large storage tanks for subsequent redistillation or cohobation. The oil floats to the surface of the receivers and appears in the glass cylindrical top already referred to. It is usually a pale yellowish-green crystalline mass, containing all the stearoptene and the more highly aromatic constituents. This is the **Direct Oil** and is known locally as *Surovo maslo*. It is removed by either pipette or spoon and transferred to glass bottles for the time being. The

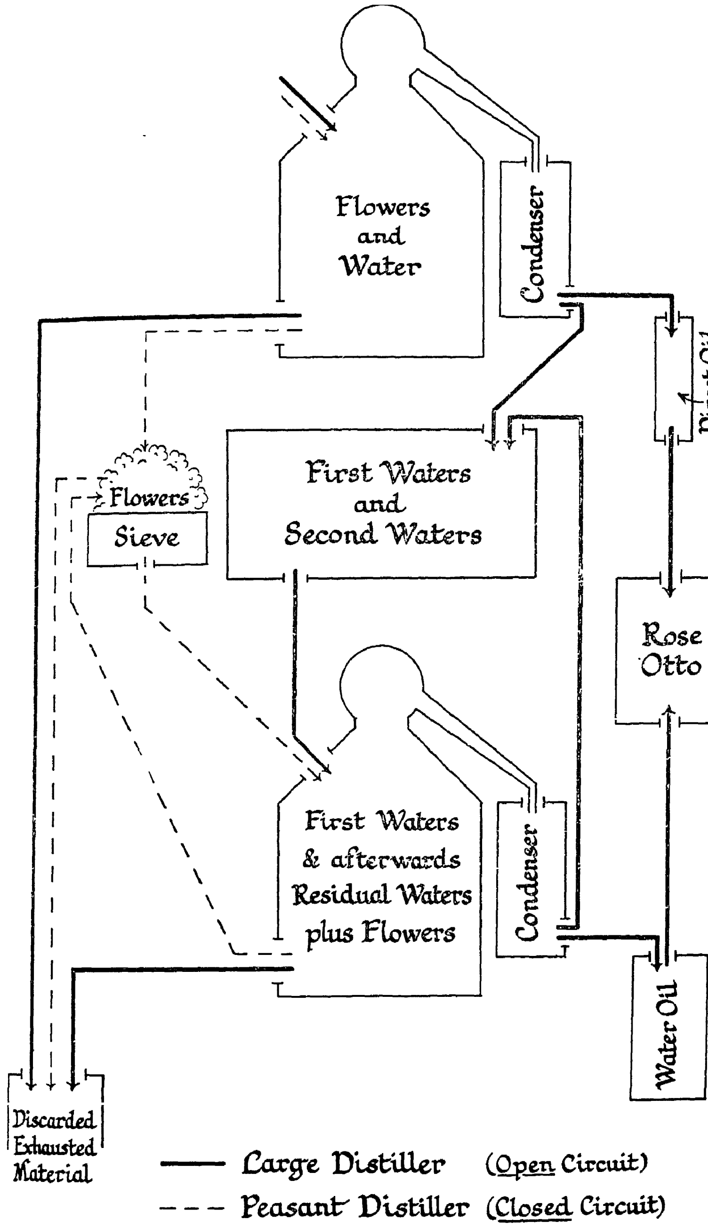

FIG. 66.—Showing difference in the two systems of distillation.

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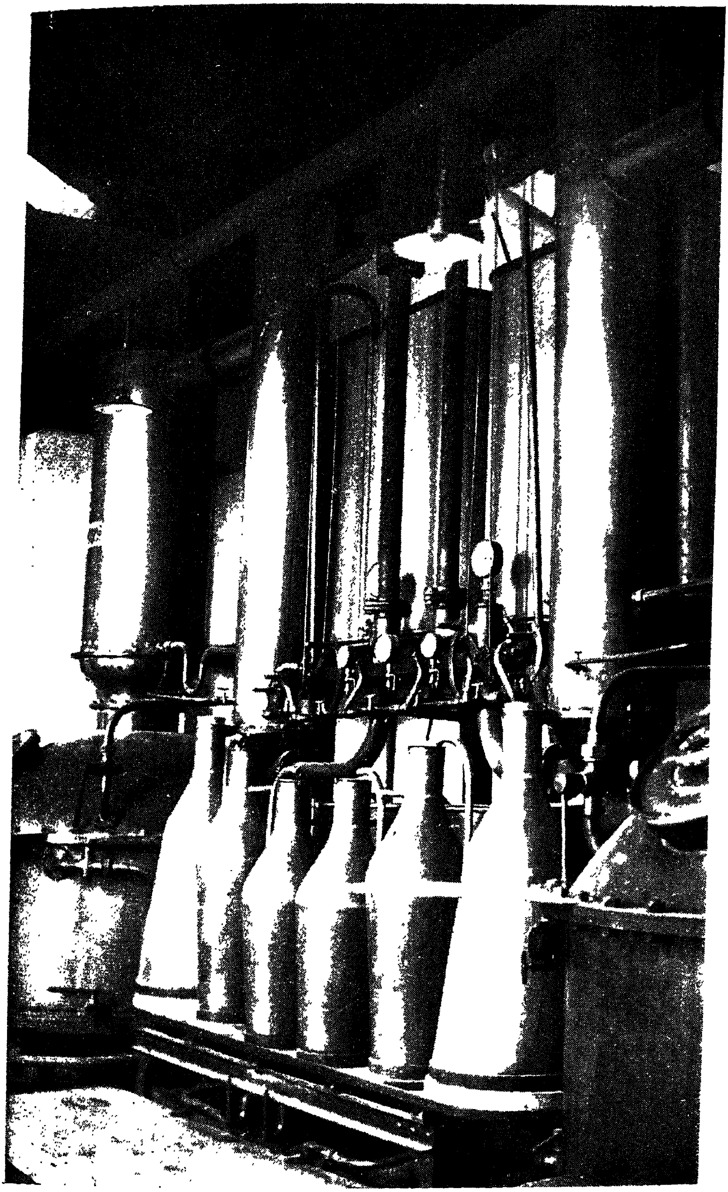
yield is comparatively small, because the major portion of the oil remains dissolved or is emulsified and in suspension in the rose water pumped into the storage tanks. This is known as the *first waters*, and when a sufficient quantity has accumulated it is transferred to the stills for cohobation or redistillation. About 1200 litres are run into each still. The fire is lighted and heat applied gently. In an hour and a half the distillate begins to pass over and the operation is completed in another hour. The condensers are operated cold since no stearoptene is present in this distillate. When some 150 litres of rose water have been collected, the distillation is stopped and roses added to the residual waters in the still. (The difference between this residual water and the peasant residuary waters above referred to will be apparent.) Distillation commences again for the production of direct oil. The above 150 litres of rose water constitute the *second waters* and are pumped into the storage tanks to join other first waters therein and to await cohobation. The oil which separates in the florentine flasks from the distillation of the first waters is known as the **Water Oil** and is referred to locally as *Prevarka*. This is always fluid. It is removed and mixed with the **Direct Oil** to constitute the Rose Oil of commerce. The yield from the first and second distillation is, from the author's actual experience in Bulgaria, never a constant ratio ; even though seemingly identical conditions were observed for repeated distillations. The approximate calculations made on the spot led to the estimate of 25 per cent direct oil as against 75 per cent water oil. These mixed runnings, as already stated, constitute the crude oil of roses. It is placed in glass bottles and exposed to the direct rays of the sun for a number of days, when impurities and colloidal matter are precipitated. The supernatant fluid is carefully decanted and filtered. Packing is done under the supervision of the local Excise authorities, who seal each of the well-known tinned copper vases and levy an export tax of about 4 per cent.

Steam Distillation.—This is carried out by a few of the larger manufacturers who have very efficient and modern apparatus, often specially constructed after much expensive experimental work. The steam is usually generated in a building adjacent to the distillery and the stills are as a rule larger than those employed for direct fire, sometimes having a capacity of 3000 litres. Two types are in existence, one having a steam coil or steam jacket and the other having a perforated direct steam coil. The latter have the advantage of more quickly raising the temperature of the water in the still and incidentally replacing part of that distilled over during the operation of the plant. For all steam stills the process, flower ratios, etc., are much the same as those already described. Owing to the ease with which the steam can be controlled it is obvious that this constitutes a distinct advantage over the direct fire systems. It is not unusual for some of the larger manufacturers to have both steam and direct fire stills in operation together. The oils from the two sources differ in odour and the latter are usually somewhat stronger and sharper, even though the bouquet is less fine. From the author's comparisons on the spot, a mixture of the two would seem to make the ideal rose otto, blended in the ratio of 2 of fire to 1 of steam oil. The largest plant has over 70 fire stills, 2 enormous steam stills and 4 concrete batteries, all of which were in continuous operation a few years ago during the peak period of perfumery sales. To-day, alas, most of them are idle.

Vacuum Distillation.—There is one large plant in operation and the process differs slightly from the foregoing. In the first distillation no oil is separated, the product being entirely rose water which is pumped into storage tanks. It is then redistilled, and yields at one operation the whole of the oil. The odour of this rose otto is of a very special character and in the author's view would be exceptionally suitable for perfumes of the white rose type.

Rotating Apparatus.—This is a modification of the plant used in Grasse for the extraction of flowers with



[*Shipkoff & Co.*

FIG. 67.—Modern Steam Stills at Rahmanlari.

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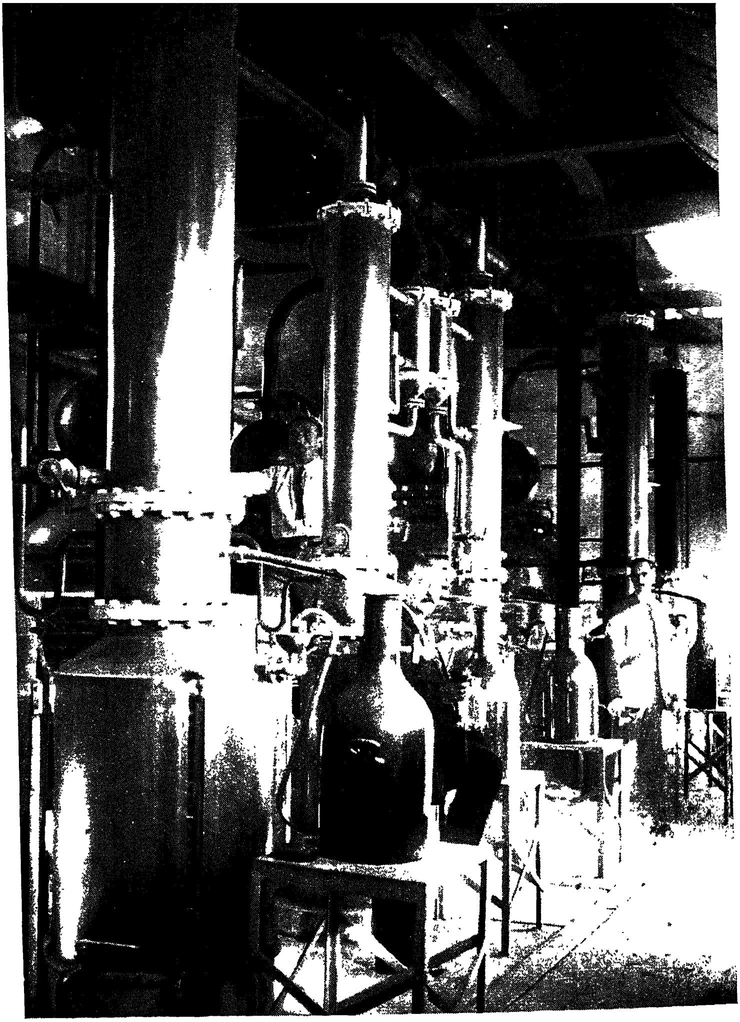


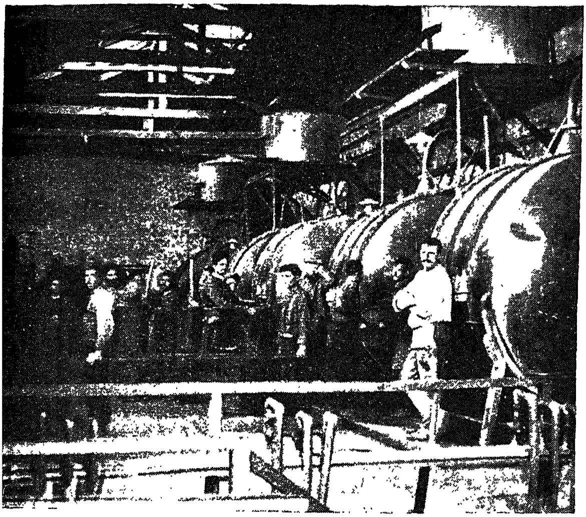
FIG. 68.—Stills at Kalofer.

volatile solvents, and was introduced into Bulgaria by Charles Garnier many years ago. It consists of a fixed vertical drum, inside of which perforated metal drums containing the blossoms revolve on a horizontal axle They continually dip into the boiling water at the bottom of the apparatus and the flowers are rapidly exhausted The actual period of extraction is considerably reduced, roughly to half that required for the fixed apparatus. Moreover, the ratio of water to flowers is less, being somewhere between three to two and two to one. Furthermore, the quantity of rose water distilled over is only about half of that necessary in the fixed apparatus. Whereas in the latter the ratio of water oil to direct oil is about three to one, it is about two to one in the rotating apparatus. The principal difference in the oil obtained is that of a much lower stearoptene content with a consequent increase in the odour to weight ratio.

Volatile Solvent Extraction.—A few of the modern factories employ this process, which was first introduced into Bulgaria in 1903 by Charles Garnier. The process is the well-known one, described earlier in this work Curiously enough, as already stated, much of the rose concrete finds a wider application in Grasse than elsewhere.

Yield of Rose Otto.—There are approximately 750 rose flowers to one kilo, and since about 3500 kilos of blossoms yield one kilo of oil, it takes 170 Damask roses to produce one drop of attar of roses. However, these figures are subject to wide variation, from 3000 kilos or less when a good yield is obtained to 4000 kilos and upwards for a poor one. The causes of these variations are to be found mainly in the atmospheric conditions. For instance, when the weather is intensely hot and dry, and especially when high winds are prevalent, the yield falls to its lowest owing to evaporation of the essence from the flowers before they are picked. Alternatively during mild conditions with occasional rain, the yield increases tremendously. The variations in the yield from steam and direct fire stills is not very great, but the advantage is generally with the latter. This may be accounted for by the higher temperatures dissolving out certain salts from the flowers, which raises the boiling-point in the apparatus with the consequent distilling over of heavier fractions of the essence. In the case of the peasant alembics the yield is even greater, and figures as low as 2500 kilos of flowers for 1 kilo of oil have been observed. This seems to be explained by the use of residuary waters previously referred to and also to prolonged distillation. While this may seem advantageous to the farmer, the forcing of the process doubtless carries over inodorous matter, which in the larger apparatus remains in the flowers. These portions act more as a natural diluent and are of no interest when the product is considered strictly from an odour standard. No data is at present available as to the constitutions of these bodies. There is a distinct and marked difference between the odour of this peasant oil and the others. The latter are characterised by a much more powerful and sharper bouquet—the strength of which is apparent after exposure on strips of clean absorbent paper. On the other hand, the farmer oil is readily distinguishable by a sweeter, more honey-like bouquet of considerably less strength. Rose otto from the large stills, having a stronger and sharper odour, was at first less appreciated by perfumers, who preferred the soft sweetness of the small distillers. In order to meet this taste, large distillers were compelled to blend their own distillate with farmer oil. All leading perfumers now prefer the strong, sharper oil because they get the same result by dilution when necessary.

Rose Trade.—Years ago this was done by buying the otto from the peasant distiller, when the whole risk was borne by him. It was the practice for the exporter to buy only when he needed the oil, or as was more frequently the case, when he had already sold it. Up to the year 1933, with the evolution of the large distiller, the whole business became more complex. It was necessary



[*La Parfumerie Moderne.*

FIG. 69.—Rose Extraction by Volatile Solvents.

[*To face page* 222.

to have agents in the villages to arrange for the purchase of flowers for the coming season. The distiller had to act as banker and advance money to the cultivator for his flowers. He had to distil himself and also to export. Moreover, following the exchanges of the different countries to which he sent his otto was imperative, if he did not wish to lose heavily on these transactions. In 1933, for various divergent reasons, the banks and co-operatives assumed responsibility for the whole rose industry and acted in all the above capacities. This does not appear to have proved a successful departure because the 1935 crop is being distilled by the private distiller, presumably with certain restrictions as to output, unrestricted production apparently being resumed during 1936.

The table shown on pages 224 and 225, summarising the state of the Bulgarian trade in Otto of Roses for the years 1927 to 1937, was compiled by the late E. Bontcheff, according to official statistics.

Anatolian Rose Otto is not a serious competitor with the foregoing. The industry was established about 1894 by a Turkish rose farmer who smuggled the rose trees into the country from Kazanlik. The chief centre of the industry is at present situated in the Sandjaks of Burdur and Isparta. The cultivation and distilling process does not differ materially from that just described. One kilo of oil is obtained from 2·300 kilos of red flowers or from 3·500 kilos of white blossoms. In 1934 there were some 420 hectares under cultivation, the plantations lying about 3000 feet above sea-level. Each hectare yields some 2·000 kilos of flowers. In the above year 725,000 kilos of petals were distilled. An exhaustive account of the whole industry is given by Bredemann in a well-known publication.[1]

French Rose Otto is produced on a very small scale, and the quantities offer no serious competition with Bulgaria. In general the plant is cultivated largely

[1] "Report" of Schimmel & Co. (1917), 42.

Years.	Rose Gardens.	Roses Collected.	Price of the Roses.	OTTO OF	
				Output.	Total Exports.
	Dekars.*	Kilos.	Levas.	Kilos.	Kilos.
1927	56,581	9,512,044	12	2517	2406
1928	58,104	5,185,101	12—15	1963	3157
1929	62,940	7,812,859	20—23	2102	2664
1930	65,204	7,427,128	20—22	1861	1752
1931	66,540	7,650,804	7	2199	1325
1932	67,000	8,384,583	7	2037	916
1933	70,680	13,252,620	5	2808	1413
1934	73,600	6,699,816	5	1750	1220
1935	73,000	12,331,494	4	2947	1671
1936	63,900	8,708,522	4	1812	1864
1937	58,000	11,230,000	4	2850	2179

* 1 Dekar = 10 ares or 1000^2 metres.

for the blossoms, which are extracted mainly by volatile solvents and by maceration. The total crop in a good year is round about one and a half million kilogrammes, and the principal centres together with their normal yields of blossoms are as follows :—

La Colle	250,000 kg.
Grasse	100,000 „
St. Paul	100,000 „
Vence	90,000 „
Pegomas	50,000 „
Tourettes	50,000 „
Montauroux	45,000 „
Le Vignal	35,000 „
Opio	30,000 „
Mougins	25,000 „

The communes of La Colle and St. Paul are the two principal centres of rose cultivation, not so much because of the nature of the soil, as undoubtedly because the insufficiency of water supply available for the work of irriga-

ROSES. Exported to:	1927.	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.	1936.	1937
	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.	Kilos
England . .	176	177	358	308	177	207	333	134	300	348	43[illegible]
France . .	1570	2035	1591	890	434	247	376	580	592	862	97[illegible]
U.S. of America	228	353	239	248	347	272	422	148	342	347	26[illegible]
Germany . .	205	174	305	148	93	116	101	174	160	121	27[illegible]
Holland . .	51	0·106	12	0·250	1	3	10	17	63	20	3[illegible]
Switzerland .	149	352	123	136	249	42	155	105	159	149	17[illegible]
Italy . . .	10	29	23	8	12	7	3	6	3	—	[illegible]
Other Countries	17	37	13	14	12	22	13	56	52	17	1[illegible]
	2406	3157	2664	1752	1325	916	1413	1220	1671	1864	217[illegible]

tion does not allow the cultivation of other crops more remunerative.

The principal species cultivated is *Rosa centifolia*, L., known in France as the Rose de Mai, of which there are two or three varieties. Between 1911 and 1914 experiments with other roses were conducted by R. M. Gattefossé, who found *Rosa Ulrich Brunner* to be well suited for the production of concrete and rose water. Other varieties, such as Louis van Houtte and Marie van Houtte, were distilled, and to-day probably enter the composition of oils of mixed origin. Other varieties of garden roses are now worked up for their perfume since they cost considerably less than the Rose de Mai, but yield concrete and absolute having a delicious rose odour.

The cultivation of roses requires considerable care, if good results are desired, and especially so when virgin soil is used for the planting. The land is first lightly ploughed in September and again to a depth of about 2 feet in October—motor ploughs being employed. The fertility of the soil is enhanced by the application of fertilizers and manure. According to Karleskind[1] January is the best month for planting, but when large numbers of shrubs are placed it is better to commence the work in November so that it can be completed by February. The most satisfactory results are obtained with plants prepared a year ahead in a nursery. These are placed in rows 1·40 metres apart with a distance of 50 cm. between each plant. This requires about 10,000 shrubs per hectare. Good irrigation is necessary, but in the first year the yield of blossoms is poor. In the autumn the trees are pruned and the ground well manured. In the following May the first real crop is collected. This reaches its maximum in the fourth or fifth year and maintains its yield until the tenth year, when it begins to decline. The crop varies from 2000 to 5000 kilos per hectare and is influenced by the situation, atmospheric conditions, and the variety of plant cultivated. The gathering is done by women and children in the early morning and while the dew is still on the blossom. The perfume is then at its best and they are paid for their work by the weight of petals collected. These are transported to the factories as quickly as possible and spread out on the floors before treatment. Approximately 70 per cent are treated by volatile solvents, 20 per cent by maceration, and the remainder by distillation. In the former case petroleum ether is the principal solvent used, but when benzole is employed the yield is increased. The odour, however, is less fine and lacks strength. This product is used for cutting the other or can, of course, be purchased separately when desired and specified. Rose absolute of North African origin will shortly become a commercial article. A sample kindly sent to the author for examination had a beautiful bouquet and compared favourably with the well-known Grasse product.

Small quantities of rose otto are distilled in Germany, India, Tunis, and Persia. In the latter country the princi-

[1] "Les Parfums de France" (1923), May 29, June 30.

Fig. 70.—The Rose Fields in Provence. [A. Chiris.

[To face page 226.

[PilarFrer.

FIG. 71.—Collecting Roses at Hyères.

[Roure-Bertrand Fi.

FIG. 72.—Sorting Roses.

[To face page 22

pal seat of the rose-water industry is at Maimand in the province of Fars, some hundred miles S.S.W. of Shiraz. The oil is only separated when specially ordered. In Italy nearly 2000 acres of ground are devoted to the cultivation of the Rose de Mai, principally between Ventimiglia and Andorra. From 6000 to 10,000 kilos of flowers yield 1 kilo of rose oil.

Generally in commerce rose otto is distinguished according to its geographical source, Bulgarian, Anatolian, French, etc., and also according to its make. One kilo of oil is obtained by distillation from the following weight (approximate) of flowers :—

1. Bulgaria	3,500 kilos.
2. Anatolia	4,000 ,,
3. France	12,000 ,,

The low yield obtained in the south of France is due to the fact that frequently the blossoms are distilled primarily for *rose water* and the oil considered a by-product.

Through the courtesy of Roure-Bertrand Fils, the author was able to make some experimental distillations at their works in Grasse during the 1933 season. Similar conditions were observed to those operating in Bulgaria, both direct and water oils being obtained. The following data emerged from their examination (figures per cent) :—

	Total Alcohols.	Citronellol.	Stearoptene.
Direct oil .	9·0	5·5	71·3
Water oil .	91·9	75·8	traces only
Total oil .	28·4	17·3	59·8

On the basis of these experiments, it requires 12,000 kilos of flowers to produce 1 kilo of direct oil, plus 9000 litres of rose water. Similar experiments at the works of Lautier Fils gave a direct oil as follows :—

Total alcohols	12·2 per cent.
Citronellol	6·3 ,,
Stearoptene	76·7 ,,

Chemistry.—The following constituents have been observed by different chemists in commercial samples of rose oil :—

l-Citronellol (principal constituent)	24 to 64	per cent.
Total alcohols as geraniol . .	63 to 84	,,
Nerol	up to 10	,,
Phenylethyl alcohol[1]	,, 1	,,
Esters of geraniol	,, 3·5	,,
Eugenol	,, 1	,,
Stearoptene	7 to 25	,,
l-Linalol, Farnesol, Citral, Nonyl aldehyde	traces.	

The recorded chemical and physical constants for commercial rose oils are :—

Specific gravity at 30° C.	0·849 to 0·865
Rotation°	− 1 ,, − 5
Refractive index at 25°	1·452 ,, 1·466
Melting-point °C.	15° ,, 24°
Alcohols as geraniol, per cent . . .	63 ,, 84
Citronellol/Rhodinol, per cent . . .	24 ,, 64
Stearoptene, per cent	7 ,, 25
Acid value	1·5 ,, 3·8
Ester value	3·7 ,, 17·5

The above figures include rose otto made by rotating apparatus, which as previously stated yields oils having a very low stearoptene content.

The most notable difference between these constants and those given in the last edition of this work is the high citronellol content admissible for Pure Rose Ottos. This drastic

[1] Oils by vacuum distillation may contain higher proportions.

change actually dates from the author's visit to Bulgaria in 1932, when he personally controlled the distillation, in large fire stills, of a considerable purchase of oil by the firm of Yardley & Co., Ltd. This oil, which was of undoubted purity, contained 55 per cent of citronellol, and it quite naturally disturbed the opinions of analysts who in England had been accustomed to reject samples containing more than 35 per cent or thereabout of this alcohol. As a proof of this, in 1932, E. J. Parry[1] stated that the maximum citronellol content of pure Bulgarian rose oils was 35 per cent, and that during the preceding 8 to 10 years he had met with samples of doubtful purity containing from 40 to 55 per cent of citronellol. This opinion was supported by the standard works of Gildemeister and Hoffmann who placed the maximum figure as 37 per cent. There were, however, prior to the above date, published statements by A. Chiris,[2] who in 1924 indicated for one sample 48 per cent, in 1929 for another sample 49 per cent, and in 1930 for a large number of pure samples, up to 55 per cent citronellol. Such a radical change as that provoked by the author's statement in a well-known English Perfumery Paper,[3] naturally led to observations and further investigations by other chemists. Charles and Robert Garnier[4] stated that normal oils, distilled by themselves in Bulgaria for some years past in modern stills, averaged from 45 to 55 per cent citronellol. In cases where they had used rotating apparatus, this figure went up to as much as 63 per cent.

E. J. Parry and J. H. Seager[5] made an exhaustive examination of authenticated samples of rose oil distilled by the co-operatives during the 1932 season and representing more than 75 per cent of the total crop. They

[1] "P. and E.O.R." (1932), 345.
[2] "Les Parfums de France" (1924), 107; (1929), 52; (1930), 332.
[3] "P. and E.O.R." (1932), 375.
[4] "Bull. Soc. Chem. de France," 8 (1933), 9.
[5] "P. and E.O.R." (1933), 149.

found 45 to 61 per cent of citronellol in these oils, which figures were much higher than the limits previously cited by one of them.

In commenting upon this investigation L. S. Glichitch and Y. R. Naves[1] expressed the opinion that such results were by no means new, but had been observed by them in numerous samples of undoubted purity since 1924. Robert Garnier[2] confirmed this statement and observed that in his opinion all good Bulgarian rose ottos, distilled in large alembics and not containing too high a proportion of oil from white roses, contain more than 40 per cent of citronellol and generally from 45 to 60 per cent. This author in collaboration with Sebastian Sabetay[3] reported on the characters of samples of 1933 crop oil when they found from 46 to 61 per cent of citronellol in rose otto obtained from different types of stills and districts. They further confirmed that ethyl alcohol is a natural constituent of the oil, a view which is not universally accepted.

E. J. Parry and J. H. Seager[4] noticed a lower tendency in the citronellol percentage of the 1933 crop oils. Fifteen samples distilled by the co-operatives gave an average of 44·6 per cent. A remarkable point emerged from their figures. The highest citronellol content (51·1 per cent) was in an oil distilled at Pavel-Bania, whereas Garnier and Sabetay in their above report observed 60·9 per cent—a striking difference of nearly 10 per cent *in the same year oil from the same district.*

From these observations, all by chemists of repute whose only interest is in the establishment of the true standards for pure oils, it is obvious that the old figures must be amended. The indications at present are that the best rose otto, that is oil from the large stills, should have a citronellol content of from 45 to 55 per cent and

[1] "Les Parfums de France" (1933), 154.
[2] "P. and E.O.R." (1933), 370.
[3] "Comptus Rendus" (1933), 197, 1748.
[4] "P. and E.O.R." (1934), 213.

that any sample below 40 per cent should be regarded with suspicion. It seems very doubtful whether any explanation will ever be found even for the wide differences observed for acknowledged pure oils. There is no doubt that the atmospheric conditions, the soil and district, the time of collection of the blossoms, the time elapsing before their distillation with the possible effects of fermentation, the ratio of red to white flowers, the type of still and also the *modus operandi* of the distiller, do affect the composition of the oil, to say nothing of its odour. As a proof of this, during the 1932 crop the co-operatives distilled at numerous villages, of which two will serve to illustrate this point. One is Sopot, situated on the north side of the Valley of Roses, towards its western end, and the other Derelie, some 15 kilometres distant on the south side of the valley. Both villages drew their flowers from the intervening district at the same time and used the same methods of distillation. Yet the oil from Sopot only contained 45 per cent citronellol as against 58 per cent in the Derelie oil.

As to the differences between the citronellol content in the last ten years compared with that of former years, the author is driven to one of two conclusions :—

1. That the evolution of the larger alembics has been responsible for the change, coupled with the fact that distillers have been compelled by keener competition to sell comparatively pure own distilled oils, their own distillation having in many cases formerly been blended with peasant oils where the process had been pushed to its extreme limits.

2. That rose otto has been deliberately and systematically adulterated with geraniol and recovered or synthetic stearoptene in quite large proportions for many years, and that previously published figures have been based upon this sophisticated oil.

In the event of the latter supposition subsequently being confirmed, buyers of rose oil would be led to some very disquieting conclusions. The implication is obvious, for it would mean that the analyst has been for many years rejecting the best and purest oils on account of their high citronellol content, and accepting as pure the very rose otto which had been adulterated.

Even to-day it is a comparatively easy matter to sophisticate rose otto scientifically because of the facility with which an artificial rose oil may be compounded from the known constituents. Some years ago the author made such an oil and published[1] its analysis by J. H. Seager. The figures came within the usually accepted limits as follows :—

Specific gravity at 30°	0·8547
Optical rotatum	— 1·7
Refractive index at 25°	1·4624
Congealing point	21·8°
Acid value	1·9
Ester value	11·6
E.V. after acetylation[2]	212·3
Citronellol by formylation	31·2 per cent
Stearoptenes	18·0 " "

Some further experiments in this connection will be referred to later.

It has been known for many years that the phenylethyl alcohol content of roses was lost during the distillation process, but it is only recently that any practical examination of the problem has been made. E. S. Guenther and R. Garnier[3] suspected that this loss occurred when the exhausted flowers and residuary waters were discarded after distillation. They cooled and filtered these residuary waters and extracted them with volatile solvents. The resulting product was examined by H. Walbaum and A. Rosenthal, who found it to consist mainly of phenylethyl alcohol together with some eugenol.

[1] "P. and E.O.R." (1932), 375.
[2] This equals total alcohols as geraniol 69·5 per cent.
[3] "American Perfumer" (1930), 624.

Evaluation of Rose Otto.—To the experienced nose, the odour of rose otto is subject to considerable variations, and these are probably due to a variety of circumstances. There are two well-defined types :—

1. The soft honeyed sweetness of the peasant oil.
2. The intense sharpness of the essence from the large fire stills. These two comprise the main part of the oils distilled, but in addition there are :—
3. The aldehydic character of the steam distilled oils.
4. The leafy heaviness of the product from vacuum stills.

There are also variations in the odour of the first two types, and the factors which may be responsible for these dissimilarities are :—

(*a*) The ratio of red to white flowers.

(*b*) The time which elapses between picking and distillation.

(*c*) Fermentation when supply exceeds still capacity or alternatively the time taken in transit to the distillery.

(*d*) The particular villages from which each distiller buys his flowers to make his own special bouquet.

(*e*) The possibility in large fire stills of slight burning of the blossoms, due to contact with the walls of the apparatus.

(*f*) The actual type of fire still, some preferring the detachable and others the fixed head.

With regard to (*d*), some of the larger firms who have several plants acknowledge the fact that the oils obtained during the same season from these different districts have a dissimilar and yet characteristic odour. Naturally these houses make a point of blending the oils from different sources so that deliveries are uniform, unless, of course, one of the large buyers states a preference for a particular oil.

Now the difficulty which faces important buyers is to know the type of oil to purchase and the source to choose. Confidence in the distiller is imperative. It is true that when the co-operatives assumed control of the rose industry the source of supply was narrowed down, the selection being made from the alternative samples submitted. However this regime has now ceased, and the author therefore proposes to discuss this question impartially and irrespective of the producer and his apparatus. In the past, buyers have quite naturally had some anxiety as to the purity of the rose otto for which they were paying a high price, owing to the reputation for sophistication, regrettably but perhaps not wholly unwarrantably associated with this product.

The fact that the constituents are known approximately and the chemical and physical constants fall within certain prescribed limits has, in the past, induced some buyers to resort to the opinion of the analyst. But since chemistry has come to the aid of the sophisticator, the reliability of chemical analysis is no longer acknowledged, excepting perhaps as an indication of the crudest adulteration. It must be borne in mind that the prime characteristic of rose otto is the fineness of its odour, and unfortunately buyers are left only with an olfactic assessment, and even this in the most experienced is subject to certain vagaries.

Some years ago the author had occasion to discuss this problem with several of the leading perfumery houses in Paris, Grasse, Switzerland and Germany. The opinions of their technical directors, chief chemists and perfumers were solicited. The system employed by all of them was the same. The best sample of the present year was taken as the odour standard for the succeeding year, bearing in mind the comparative crudity of freshly-distilled oil. The favoured sample was in one case only subjected to analytical examination, the constants being used as an additional check on bulk deliveries.

It may be that some readers will have doubts as to the soundness of this procedure, but the author recently made the following experiments in collaboration with a well-known essential oil analyst, and the results will indicate the unreliability of a chemical examination.

A quantity of artificial rose otto was prepared more or less on the lines of the known constituents, but containing 0·3 per cent of aldehydes and 15 per cent of synthetic stearoptene. It was matured for one month to develop roundness and intensity of odour. Eight samples of rose otto were sent to the author's collaborator for examination, as follows :—

1. 80 per cent fire distilled oil + 20 per cent palmarosa geraniol.
2. 80 per cent steam distilled oil + 20 per cent citronellol.
3. 30 per cent steam distilled oil + 70 per cent fire distilled oil.
4. 80 per cent fire distilled oil + 20 per cent rose compound.
5. 50 per cent fire distilled oil + 30 per cent steam distilled oil + 20 per cent rose compound.
6. 100 per cent fire distilled oil.
7. 90 per cent fire distilled oil + 5 per cent geraniol + 5 per cent synthetic stearoptene.
8. 93 per cent fire distilled oil + 7 per cent peasant oil from white roses only.

The results were not surprising. Samples 1 and 2 (crude adulteration) and 8 were rejected and the remainder (including 4 and 5 skilful and 7 semi-crude sophistication) were passed as pure oils of good quality. This evidence would seem to be conclusive proof of the case against an assessment on an analytical examination only.

Summing up, therefore, the two alternative methods of purchase of rose otto, and having in mind many years' experience of the product, the author is of the carefully considered opinion that the ratio of reliability is about 75 per cent olfactic as against 25 per cent chemical evaluation by so far known methods. On reflection, this would seem to be the logical conclusion, because the consumers of rose otto sell odour and must therefore buy on this basis.

Olfactic Examination.—All essential oils have two well-defined attributes—*Bouquet and Strength.* They may be assessed separately, the results being ultimately collated. An examination of the *bouquet* is made in the case of rose otto by adding one drop of the oil to 100 c.cs. of distilled water at 42° C. in clean brandy glasses. Each glass may be examined carefully without olfactory fatigue, and all of them placed in the order of preference. This process is repeated every hour for six hours and then on the following morning. A note of the order is made after each examination and it will generally be found that certain samples persistently fall into the first places. An assessment of the *strength* is made by impregnating clean strips of absorbent paper with a standard quantity, usually in the case of rose otto 0·05 gram, and exposing them at room temperature under identical conditions. The odour is observed and noted between 10 and 11 a.m. daily for 10 days. The results are classified in the order: strong, 3 points; medium, 2 points; and weak, 1 point. After the tenth day the points are totalled, and if those having the highest figures correspond with those taking first places under the bouquet tests, then the best quality product is indisputably established.

In order to check the value of this method of odour evaluation the author adulterated an authenticated pure rose oil with 5, 10 and 20 per cent of a rose compound analysing as pure rose otto. The *strength tests* were the only means of detecting the adulteration, the weakening of the odour of the oil being in ratio to the proportion of adulterant used. For instance, the 20 per cent sample was the first to show a marked difference in odour at the end of 4 days and the 10 per cent at 7 days. In the 5 per cent, the difference was indetectable with certainty. The *bouquet* tests can only be taken as valuable in conjunction with the *strength* tests. That is to say, if an oil has a fine bouquet but is weak, then it would be suspicious, whereas a strong oil of poor bouquet would indicate that the stills, the method of operation, or the flowers in that particular instance were capable of improvement. If, however, as already stated, the same oil appeared high in both tests, then it could reasonably be assumed to be of the finest quality.

Compounding Notes.—Pseudo-rose oils are now manufactured on a large scale, and they vary in price according to the amount of genuine natural otto contained, for it is admitted that the reproduction of the true odour is impossible at present by means of known synthetic aromatic chemicals alone. The field from which the constituents may be chosen is a large one, since the esters of all the basic alcohols are now obtainable in a wide range, and also the higher alcohols and aldehydes are made in greater purity. Of the bases, **rhodinol** is unquestionably the finest, for its odour approximates more nearly to that of otto than any other alcohol. Geraniol from palmarosa oil, nerol, dimethyl octanol and citronellol are also good, while terpeneless oil of rose geranium (French) is a very valuable base. **Phenylethyl alcohol** is indispensable in all compounds and is used up to 25 per cent. Of the modifiers, the esters of the above alcohols are all used, but rhodinyl acetate and phenylethyl propionate have probably the most pronounced red rose odours. They may be used if desired to replace a part of the usual phenylethyl alcohol content. Other modifiers which impart a remarkable freshness to rose compounds are alpha ionone, hydroxy-citronellal, and terpineol. The most valuable aldehydes are represented by C_9, C_{11} and C_{12}, and their corresponding alcohols are also useful. Octyl aldehyde has been recommended as being superior to nonyl aldehyde, but practical results do not confirm this. Octyl alcohol is, however, a very useful constituent. Mere traces of these powerful products are sufficient, and about 0·1 per cent is the best proportion. The typical honey odour is a difficult thing to duplicate, but traces of phenylacetic acid will be found useful or alternatively the honey compound (Miel), described in Volume I. The basic rose oil is completed by the addition of one or more of the suitable fixers recommended in the chapter on that subject and by the judicious use of the natural product. A good deal of "body" may also be imparted by the inclusion of a suitable quantity of benzyl isoeugenol or cinnamic alcohol. When the synthetic rose base has been compounded it should be allowed to mature for at least one month, when the rough edges will have disappeared. The creation of special types is best accomplished by adding the necessary modifiers to the basic rose oil, and in almost all cases *traces* will be found sufficient. The following list will indicate the lines on which to proceed :—

R. Banksian .	Alpha ionone or orris oil.
Canina . .	Basil oil or ethyl decine carbonate.
Desprez . .	Ethyl cinnamate or rhodinyl butyrate.
Eglantine . .	Benzyl acetate and hydroxy-citronellal or phenylethyl acetate or isobutyl phenylacetate.
Marechal Niel .	Guaiac-wood oil and undecalactone or iso-butyl acetate.
Moschata . .	Iso-eugenol.
Muscosa . .	Oakmoss resin (colourless).
May . . .	Cinnamic aldehyde.
Socrates . .	Undecalactone.
Unique jaune .	Phenylacetic aldehyde or cinnamic alcohol.

Synthetic Components :—

Bases.—Geraniol, rhodinol, citronellol, nerol, dimethyl octanol, phenylethyl alcohol, rose geranium oil—French.

Blenders.—Linalol, phenyl propyl alcohol, palmarosa oil, bergamot, phenylethyl phenylacetate, iso-butyl phenylacetate, guaiac-wood oil, bois de rose oil, lemon oil, cinnamic alcohol.

Modifiers.—Phenylethyl propionate, geranyl acetate, and all other esters of the above alcohols, eugenol, alpha ionone, terpineol, ylang-ylang oil, hydroxy-citronellal, phenylacetic acid and aldehyde, orris, basil, ethyl cinnamate, benzyl acetate, methyl octine carbonate.

Fixers.— Musk ketone, patchouli, vetivert, santal, benzyl iso-eugenol, benzoin, vanillin, styrax, tolu, salol.

Florales.—Rose otto and absolute, other flower absolutes according to type.

Aldehydes.—C_9, C_{11}, C_{12}.

The following formulæ will give a general indication of the composition of specific types :—

Rose Otto, No. 1090.

(A remarkable copy of the Bulgarian oil.)

400	Geraniol from palmarosa oil.
60	Geranium over roses—terpeneless.
200	Nerol.
90	Phenylethyl alcohol.
40	Alpha ionone.
10	Eugenol.
15	Linalol.
35	Geranyl acetate.
10	Orris oil—liquid.
20	Rhodinyl formate.
1	Nonyl aldehyde.
2	Undecylic „
2	Laurinic „
7	Vanillin.
8	Musk ketone.
100	Rose otto—Bulgarian.
1000	

Rose Centifolia, No. 1091.

250	Rhodinol.
350	Citronellol.
100	Phenylethyl alcohol.
100	Jasmin, No. 1053.
60	Cinnamyl cinnamate.
40	Alpha ionone.
20	Phenylethyl formate.
4	Anisic alcohol.
1	Ethyl methyl phenyl glycidate.
4	Undecylic aldehyde, 10 per cent.
20	Nonyl aldehyde, 10 per cent.
20	Rose otto—French.
10	Rose absolute—Benzole.
1	Methyl heptine carbonate.
20	Phenylacetaldehyde dimethylacetal.
1000	

Red Rose, No. 1092.

250	Rhodinol.
100	Rhodinyl acetate.
30	Geranyl benzoate.
60	Citronellyl propionate.
20	Cinnamic alcohol.
100	Methyl ionone.
50	Bergamot oil.
70	Jasmin colourless, No. 1055.
30	Benzyl cinnamate.
5	Orris oleo-resin.
4	Nonyl alcohol.
1	Undecylic aldehyde.
40	Rose absolute.
60	Geranium oil—French.
30	Musk ketone.
50	Guaiac-wood oil.
100	Phenylethyl alcohol.
1000	

White Rose, No. 1093.

400	Geraniol from palmarosa oil.
275	Citronellol.
25	Hydroxy-citronellal.
25	Jasmin absolute.
9	Patchouli oil—English.
1	Vetivert oil—English.
5	Octyl aldehyde, 10 per cent.
10	Nonyl alcohol.
50	Rose oil—Bulgarian.
50	Benzyl acetate.
50	Ionone alpha.
40	Santalwood oil.
60	Phenylethyl acetate.
1000	

Rose d'Orient, No. 1094.

400	Rhodinol.
200	Citronellol.
130	Nerol.
1	Ethyl cinnamate.

18	Benzyl acetate.
10	Alpha ionone.
1	Aldehyde C_{16}.
30	Nonyl alcohol.
10	Decyl aldehyde, 10 per cent.
100	Benzoin R.
100	Otto virgin.
1000	

Alcoholic Perfumes may be prepared as follows :—

No. 1095.

80	Rose centifolia, No. 1091.
10	Musk extract, 3 per cent.
10	Civet
900	Alcohol.
1000	

NOTE.—Any of the above synthetic rose ottos can be solidified by the addition of 10 per cent of *cetaceum*.

SWEET PEA.

History.—Classical literature contains no references of importance to this very charming garden plant. Theophrastus mentions a few field peas, and there is one reference to tine-tare, *Lathyrus tuberosus*, but in this case it occurs when he is describing various roots.[1] The origin of the plant as we know it to-day, with its delightful perfume, appears to be somewhat obscure. It is generally believed to be a native of the Island of Sicily where it is occasionally found growing wild. Its introduction to English horticulture appears to be in the early part of the eighteenth century. In the language of flowers, sweet peas are to-day emblematic of "delicate pleasures."

Varieties.—The genus *Lathyrus* comprises a number of hardy annual and perennial plants much appreciated for decorative purposes in our gardens. They belong to the

[1] "Enquiry into Plants," i., 6, 12.

N.O. Leguminosæ and the sub-order Papilionaceæ and are closely allied to the Vetches. Botanically the sweet pea is *L. odoratus*, but in common parlance other varieties often bear this description. Some of the more interesting of these are as follows :—

L. latifolius. The common everlasting pea found throughout Europe. Flowers rose-coloured and some white and striped, 4 to 5 ft. high, blossoms July and August.

L. grandiflorus. Large flowered or two-flowered everlasting pea, common to Southern Europe. Purplish-rose flowers appearing at their best in June.

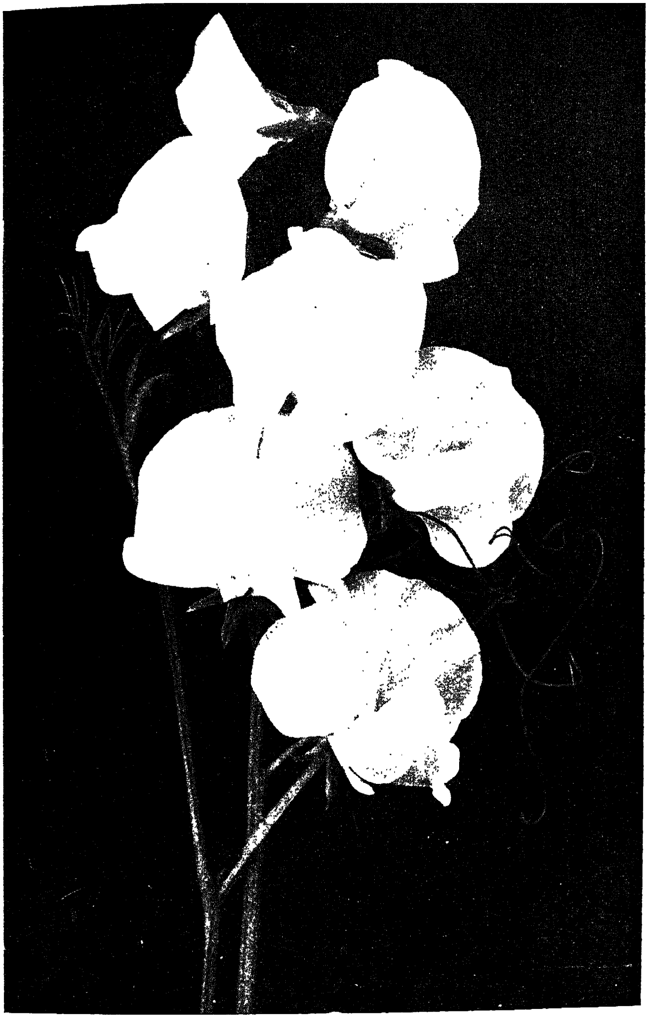
L. rotundiflorus. Round leafed everlasting pea. Persia and Asia Minor. Flowers bright crimson-red. June to August.

L. tuberosus. Tine-tare, Dutch mice, Fyfield pea, tuber pea. Common throughout Europe. Rather short and rambling. Bright rose flowers. July and August.

Odour.—The sweet pea bears elegant and many coloured flowers of delicate and sweet fragrance. Their odour recalls that of orange blossom and hyacinth with a suggestion of rose.

Natural Perfume.—This is not an article of commerce, although there is every reason to believe that enfleurage would capture the flower perfume faithfully. Since the duplication of the odour is fairly easily attained by the skilful blending of synthetics, it is doubtful whether the production of the natural perfume would meet with any great demand. The composition of this is not known, but the odour would at once suggest the presence of methyl anthranilate.

Compounding Notes.—Before the advent of synthetics of orange blossom or hyacinth odour it was customary to base the sweet pea perfumes upon orange blossom extract. This was blended with rose and tuberose and fixed with



[*Sutton & Sons.*

FIG. 73.—Sweet Peas.

[*To face page* 242.

vanilla. To-day the usual orange blossom constituents with phenyl acetaldehyde form the basis of the best compounds. Some perfumers prefer the dimethyl acetal of the latter as reproducing the typical green character more accurately. Others favour methyl heptine carbonate or methyl nonyl ketone for this purpose. Benzylidene acetone in extreme dilution has an odour closely approximating that of the flower. It is therefore often used as a base, but since the odour of this substance in the crude state is rather powerful, sharp, and penetrating, its use requires care and moderation. Moreover, it has an irritating action on some skins and should thus be used in the minimum quantity possible to yield the desired odour result. Benzyl acetone or phenylethylidene acetone have similar odours and may be used to replace it if desired. To develop the odour value of these substances it is necessary to blend them with hydroxy-citronellal, phenylethyl acetate, terpineol, and heliotropin. Artificial neroli and natural bergamot are also indispensable. Rose, jasmin, jonquille, orange blossom, and tuberose are all suitable floral additions, and fixation is completed with ambrette musk, vanilla or tolu balsam.

Synthetic Components :—

Bases.—Phenylacetic aldehyde, artificial neroli, linalol, French petitgrain, benzylidene acetone, benzyl acetone, phenylethylidene acetone.

Blenders.—Terpineol, heliotropin, bergamot, geraniol, phenylethyl alcohol, nerol, methyl anthranilate, mandarin, sweet orange, phenylethyl acetate, hydroxy-citronellal.

Modifiers.—Rue oil, methyl nonyl ketone, geranyl formate, iso-butyl phenylacetate, alpha ionone, ethyl phenylacetate, ylang-ylang oil, nonyl alcohol, methyl heptine carbonate.

Fixers.—Vanilla, methyl naphthyl ketone, tolu balsam, musk ambrette, vanillin, benzoin, guaiac-wood oil.

Florales.—Orange blossom and neroli, rose otto and absolute, jonquille, jasmin, tuberose.

Aldehydes.—Phenyl propyl, methyl nonyl acetic, amyl cinnamic, C_9, C_{10}.

Numerous modifications can be based upon the following type formula :—

Sweet Pea, No. 1096.

150	Neroli, No. 1081.
100	Phenylacetic aldehyde.
100	Terpineol.
100	Bergamot oil.
200	Linalol.
30	Sweet orange oil.
50	Alpha ionone.
40	Iso-butyl phenylacetate.
5	Ylang-ylang oil—Bourbon.
30	Vanilla extract, 10 per cent.
5	Rose otto.
20	Orange blossom absolute.
10	Jonquille absolute.
2	Methyl nonyl acetic aldehyde, 10 per cent solution.
18	Methyl nonyl ketone, 5 per cent in hydroxy-citronellal.
30	Musk ambrette.
60	Methyl naphthyl ketone.
40	Heliotropin.
10	Benzylidene acetone.

Alcoholic Perfumes may be blended with the floral extracts and the above-mentioned synthetic components or by the use of the floral oil thus :—

No. 1097.

60	Sweet pea, No. 1096.
5	Siam benzoin R.
2	Tolu R.
3	Civet extract, 3 per cent.
5	Musk ,, ,,
2	Nerol oil, bigarade petals.
3	Jonquille absolute.
5	Rose ,,
10	Jasmin ,,
5	Orange blossom.
900	Alcohol.

TRÈFLE.

History.—Trefoil appears to have been known from time immemorial, and Pliny[1] describes three varieties, the leaves of which were much used for making chaplets. In another part[2] of his voluminous works he mentions four remedies derived from the plant, the most important being presumably that it will cure the stings of serpents and scorpions.

Clover abounds in Ireland, and thus the strong belief has come about that this plant is the traditional shamrock. Some botanists, however, are of opinion that the emblem was obtained from the wood sorrel. According to the legend, the Pope Celestine sent St. Patrick to preach the gospel to the Irish. He landed at Wicklow in A.D. 433 and explained the doctrine of the Trinity by alluding to the triple leaflets of a plant he took from the ground. (It may have been *T. minor.*)

The Plant.—The common red clover *Trifolium pratense*, N.O. Leguminosæ, is grown extensively in our pastures as a food for cattle. There are several varieties, by some botanists considered as distinct species, and many of them are mentioned by Theophrastus and other ancient writers. The most popular garden variety is *T. incarnatum*, the carnation or scarlet clover, and the odour exhaled by its charming flowers has led to the creation of many perfumes bearing the name. Another variety possessing a beautiful honey-like fragrance is *T. odoratum*, a native of Italy. Other varieties are :—

T. medium, the zig-zag clover.
T. hybridum, the alsike clover.
T. repens, the white or Dutch clover.

T. pennsylvanicum, a native of the United States, resembling the latter, and extensively grown in this country, large quantities of seeds being imported annually from America. During the daytime the follicles of clover are

[1] Book XXI, chap. 30. [2] Chap. 88.

fully expanded, but as night approaches they fold back, umbrella fashion, on to the stalk.

Natural Perfume.—The odour of clover is not extracted on a commercial scale, and the trèfle perfumes marketed by so many firms contain no real clover perfume. The floral note is in all cases obtained with other flower absolutes. The blossoms all exhale a honey-like fragrance which in practical perfumery is based upon one or other of the salicylates.

Chemistry. — The chemistry of this perfume has so far received very little attention. H. Rogerson[1] distilled the flowers of *T. incarnatum* and obtained 0·029 per cent of a powerfully odorous pale yellow volatile oil. He was able to identify furfural as a constituent. Power and Salway[2] distilled *T. pratense* and obtained a yield of 0·028 per cent. The same aldehyde was identified in this oil.

Compounding Notes.—The basis of many trèfle perfumes is amyl salicylate, and this may be used up to 60 per cent of the total. Iso-butyl salicylate is a similar body which may replace it and can be used in like proportions. The blenders and modifiers include ylang-ylang, bergamot or linalyl acetate, oakmoss, and clary sage. A floral note is obtained with rose, tuberose, jonquille, and/or jasmin absolutes, while suitable fixators may be chosen from benzoin, tolu, dimethyl hydroquinone, coumarin, vanillin, musk, and phenylacetic acid.

Synthetic Components :—

Bases.—Amyl and iso-butyl salicylates and/or benzoates, dimethyl salicylate.

Blenders.—Geraniol, citronellol, nerol, lavender oil, bergamot oil, phenylethyl alcohol, linalol.

Modifiers.—Ylang-ylang, benzyl acetate, hydroxy-citronellal, citronellyl formate, oakmoss, clary sage, linalyl

[1] "Journal Chemical Society," 97 (1910), 1004. [2] *Ibid.*, 232.

[*R. A. Malby*.

FIG. 74.—Trifolium Incarnatum.

[*To face page* 246.

formate, neroli artificial, anisic aldehyde, clove oil, heliotropin.

Fixers.—Benzoin, tolu, coumarin, vanillin, musk ketone, phenylacetic acid, dimethyl hydroquinone, vetivert, patchouli, santalwood, benzophenone.

Florales.—Jonquille, rose, jasmin, tuberose.

Aldehydes.—C_{14}, C_9, C_8.

Formulæ illustrating the use of the bodies are given below :—

Trèfle, No. 1098.

500	Amyl salicylate.
100	Ylang-ylang oil—Manila.
70	Bergamot oil—terpeneless.
10	Clary sage oil.
20	Mousse de chêne absolute.
30	Anisic aldehyde.
10	Lavender oil.
20	Rose, No. 1090.
50	Jonquille, No. 1074.
20	Jasmin, No. 1054.
6	Patchouli oil.
4	Vetivert oil.
30	Neroli, No. 1081.
18	Benzoin R.
2	Gamma undecalactone, 10 per cent.
10	Phenylacetic acid.
30	Musk ketone.
70	Coumarin.
1000	

Trèfle, No. 1099.

600	Iso-butyl salicylate.
150	Cananga oil—terpeneless.
100	Linalyl acetate.
30	Oakmoss resin.
40	Lavender oil—French.
10	Rose absolute.
10	Jasmin ,,
20	Clary sage oil.
20	Iso-butyl phenylacetate.
10	Phenylacetic acid.
10	Coumarin.
1000	

Alcoholic Perfumes may be compounded from either of the above floral oils or on the lines indicated below :—

No. 1100.

70	Trèfle, No. 1098.
2	Ylang-ylang oil—Manila.
1	Vanillin.
2	Neroli oil—bigarade.
10	Musk extract, 3 per cent.
5	Benzoin R.
2	Tuberose absolute.
3	Jonquille ,,
5	Jasmin ,,
900	Alcohol.
1000	

TUBEROSE.

History.—*Polianthes tuberosa*, L., belongs to the N.O. Amaryllidaceæ, and is believed to be a native of either Mexico or the East Indies. The origin of the plant's introduction into Europe is not very clear. As far as is known, Peiresc was the first cultivator of the flower in Provence. It is said that he sent Father Minuti, one of the Minim brothers, to Persia especially for it, and that the first bulb was planted in his garden at Beaugencier about 1652. Another version is that Trovar, a Spanish physician, imported the first bulbs from Ceylon in 1594, and from Spain cultivation spread to the south of France. The tuberose is at present largely cultivated in Italy for its bulbs, which form an article of trade and are exported to this and other countries. It was first cultivated in Britain about the year 1630, and is sometimes called *Hyacinthus tuberosus* and *H. Indicus*. It derives its generic name from *polis* a city and *anthos* a flower, literally, flower of the city, and should not be confounded with polyanthus of the primrose family or with *Narcissus polyanthus*.

The tuberose has for years been regarded as the symbol of voluptuousness, and the reasons for this may be traced

[*A. Chiris.*

Fig. 75.—Tuberoses.

[*To face page* 248.

[*Lautier Fils.*

FIG. 76.—Collection of Tuberoses at Grasse.

[*To face page* 249.

to the beliefs of some of the older writers who generally considered the perfume to be slightly intoxicating. For instance, one writer recommends good girls not to breathe the odour of the tuberose on a fine evening, because its subtle perfume throws one into a voluptuous intoxication from which one does not easily become liberated.

The Plant has a tuberous rootstock, from which grows an erect stem, 3 or 4 feet high, with a few slender long leaves and bearing from 14 to 16 pairs of flowers. In the south of France the bulbs are planted in April, about 1 foot apart, and between each row is left sufficient space for the collector to pass along and pick off each flower as it opens (fully opened flowers do not yield continuously to enfleurage but wither and spoil the pomade). This occurs about mid-day, and the flowering season lasts from the end of July to the early part of October. In November the roots are removed from the ground and stored in dry sand to preserve them. The principal centre of cultivation is at Pegomas, and the total crop in a good year averages about 50,000 kilos of blossoms. Recently, however, owing to the declining demands of the perfumer for tuberose absolute the crop has fallen considerably. In 1926 it was about 30,000 kgs. while in 1927 it fell to 17,000 kgs.

There are several varieties of tuberoses. 1. The large flowered kind, which is the one generally cultivated for the extraction of its perfume. 2. The small flowered variety. 3. The streaked-leaf form. 4. The double-flowered variety grown from seeds by Lecours about 1760 at Leyden. 5. "The Pearl," grown by Henderson in the States in 1865. 6. *Polianthes Blissii*, a hybrid grown by Blin in 1905 by crossing *P. tuberosa* with *Bravoa geminiflora*. Other varieties are known and include Albino and Excelsior.

Odour.—The flowers of tuberose emit a most delightful fragrance, which in itself is a wonderful bouquet, and has been compared with the perfume of a well-stocked flower garden at evening close. In the East these white tubular flowers emit a most powerful odour which increases after sunset, and on this account is called by the Malays "Mistress of the Night."

Natural Perfume.—This is extracted generally by enfleurage, as the flower continues for 48 hours to produce odoriferous bodies while in contact with the fat. This pomade is extracted with alcohol to produce the "Absolute from Pomade," 150 kilos of flowers producing about 1 kilo. The flowers are also extracted direct by means of volatile solvents, and the *absolute* obtained by this means is one of the most expensive natural flower products; 1200 kilos of flowers produce 1 kilo of concrete which in turn yields only about 200 grams of absolute. The yield by these two processes differs largely, and according to experiments conducted by Hesse[1] the former method produces 13·32 times more essential oil than the latter. Niviere[2] is of the opinion that the larger yield to enfleurage is subject to variation according to the percentage of lard employed. There is a general opinion amongst perfumers that many of the so-called tuberose absolutes are in fact blends in which the absolute from pomade predominates.

Chemistry.—The volatile oil has been analysed, but no quantitative figures have been published. Among those constituents which have been identified by Hesse and Verley[3] are the following:—

Benzyl alcohol
Benzyl benzoate
Methyl anthranilate
Methyl benzoate
Methyl salicylate
A ketone, called tuberone.

[1] "Report" of Schimmel & Co., October, 1903, 67.
[2] "Parfumerie Moderne" (1923), 168.
[3] "Berichte" through "Year Book of Pharmacy" (1903), 166 and 167.

The methyl anthranilate is believed to average about 2 per cent and the ketone 10 per cent. F. Elze[1] has made a further examination of tuberose oil, steam distilled for the absolute, and in addition to the above-mentioned constituents has found :—

Eugenol
Geraniol
Nerol
Farnesol.

The alcohols were combined in part with acetic and propionic acids.

Compounding Notes.—The synthetic bases are almost confined to methyl, ethyl, and iso-butyl benzoates and methyl salicylate. The former has a strong coarse odour and requires careful handling; ethyl is better. The blenders which may be added are linalol, benzyl acetate, benzyl alcohol, geraniol, and iso-butyl phenylacetate. The modifiers include ylang-ylang, jasmin, methyl anthranilate, heliotropin, benzyl butyl-oxide, and sometimes traces of para-cresyl phenylacetate. Balsam of Peru, iso-eugenol, cinnamic alcohol, vanilla and nonyl-lactone are excellent fixators.

Synthetic Components :—

Bases.—Iso-butyl, ethyl and methyl benzoates, phenylethyl cinnamate, methyl salicylate.

Blenders.—Linalol, geraniol, benzyl acetate, benzyl formate, iso-butyl phenylacetate, hydroxy-citronellal, phenylethyl phenylacetate, cinnamyl formate and butyrate, geranyl formate, celery seed.

Modifiers.—Ylang-ylang oil, methyl anthranilate, *p*-cresyl acetate and phenylacetate, rhodinyl butyrate, ethyl laurinate, amyl cinnamic aldehyde, heliotropin.

Fixers.—Peru balsam, musk ambrette, coumarin, labdanum, iso-eugenol, cinnamic alcohol, vanilla, nonyl-lactone.

[1] "Riechstoffindustrie," 3, 1928, 154.

Florales.—Jasmin, neroli, rose, tuberose from pomade.
Aldehydes.—Amyl cinnamic, C_{10}, C_{12}.

Formulæ follow :—

Tuberose, No. 1101.

200	Linalol.
100	Cinnamyl formate.
50	Ethyl benzoate.
100	Ylang-ylang oil—Bourbon.
70	Geraniol.
70	Benzyl acetate.
50	Nonyl-lactone.
20	Methyl anthranilate.
100	Peru balsam.
30	Rhodinyl butyrate.
40	Methyl salicylate.
50	Tuberose absolute from pomade.
20	Amyl cinnamic aldehyde.
10	Labdanum—Clair.
10	Musk ambrette.
50	Heliotropin.
30	Iso-eugenol.
1000	

No. 1102.

300	Geraniol from palmarosa oil.
200	Cananga oil.
20	Neroli oil.
40	Methyl benzoate.
20	Iso-butyl salicylate.
300	Bois de rose oil.
5	Civet absolute.
20	Styrax R.
30	Benzoin R.
30	Tuberose absolute from pomade.
15	Jasmin absolute.
20	Heliotropin.
1000	

Alcoholic Perfumes may be prepared from the above compounds as follows :—

No. 1103.

70	Tuberose, No. 1101.
5	Jasmin absolute.
3	Rose ,,
2	Neroli oil.
10	Ambergris extract, 3 per cent.
10	Musk extract, 3 per cent.
900	Alcohol.
1000	

It should be noted that tuberose perfume is seldom sold as such, but is generally used to enhance the floral note of bouquet compositions.

VIOLET.

History.—*Viola odorata* is a perennial herb of the N.O. Violaceæ, native of Britain, and found growing in woods and on the banks of our waysides. It appears to have been a great favourite even as far back as the pre-Christian era, for we find references to it in the works of Theophrastus (400 B.C.) and Ovid (43 B.C.). The latter has given us a story in Book I of his "Metamorphoses," from which we gather that the violet took its name from Io, the daughter of Inachus. She was loved and ravished by Jupiter and changed by him into a heifer to avoid detection by Juno. Flowers (presumably violets) were caused to grow in the pastures around her in order that her grass might be distinguished from that of other animals. She was driven over the world by a gadfly sent by Juno, and at last came to the banks of the Nile, where she regained her human form. Her son was worshipped in Egypt as Isis. The violet is also mentioned by Horace, Pliny, and Juvenal the Roman satirist. Pliny called the white violet the "first messenger of spring," and he so esteemed its perfume that he placed it immediately after roses and lilies. At that time the purple violet was called "Ion" after the Greek, and from it ionthine (violet-coloured) cloth took its name. Pliny describes 17 remedies derived from this flower. Mahomet, the prophet, appears to have gone further than this, for he compared the flower to the superiority of El Islam above other religions, while in the Koran he suggests that his superiority over other men is like that of the violet perfume over all others. About the year 1600 Herrick and Rapin enlarged on the possible origin of the flower, but their theories do not appear as probable as the one given above. The violet is the emblem of the Bonapartes, the flower having been adopted by the followers of the first Napoleon when in exile. He was styled Père la Violette, and a small bunch of violets hung up in the house or worn by a Frenchman denoted the adherence of the wearer to his fallen chieftain's cause. Within comparatively recent years the violet has been valued on account of its supposed medicinal qualities. The roots were stated to have emetic properties, and on that account to have been used as an adulterant of ipecacuanha (?) The leaves were used in the form of an infusion, which was applied both internally and externally as a supposed cure for cancer, while even to-day a syrup made from the petals (?) is an ordinary galenical obtainable from any pharmacist.

Sweet violets are nowadays highly prized for their delightful fragrance, both in Europe and the East. In the south of France they are cultivated for the extraction of their odoriferous constituents, and the blossoms are collected from the beginning of the year to March and April, while in Palestine the flowers bloom with the hyacinth and narcissus in January, and are used by the native women to adorn their dark tresses.

Varieties.—According to Sawer[1] there are nine distinct varieties of *Viola odorata*, L., both single and double, which are finely perfumed, and these include the following :—

Devon, dark blue and very fragrant.
Neapolitan, lavender blue, large double flowers.

[1] "Odorographia," I, 104.

[A. Chiris.

FIG. 77.—Parma Violets.

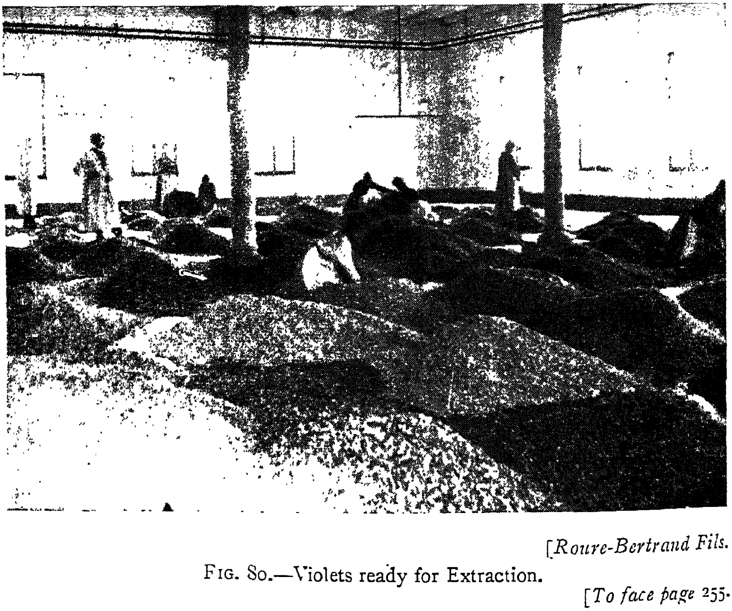
[A. Chiris.

FIG. 78.—Victoria Violets.

[To face page 254.

[Lautier Fils.

FIG. 79.—The Collection of Violets.



[Roure-Bertrand Fils.

FIG. 80.—Violets ready for Extraction.

[To face page 255.

The Czar, large deep violet flowers, delightfully perfumed.

Victoria, single deep blue flowers on long stems.

Victoria Regina, larger flowers of a rich violet-blue, and most odoriferous.

In the south of France (Grasse and Hyères districts) Parma and Victoria violets are cultivated and sold as cut flowers, being sent to the capitals of Europe. According to a French periodical [1] a variety of Victoria violets known as "*Luxonne*" is the only kind of this species now cultivated for perfumery purposes.

Odour.—It is doubtful if the perfume of any other flower is as popular as that of the violet, and the odour of cassie blossom is the only one which bears any marked resemblance to it. Orris and costus roots when dried develop an aroma which is similar.

An odour of violet type has been noticed also in the following:—

Flowers of *Ochrocarpus siamensis*, T. Anders, an Indian tree belonging to the N.O. Guttiferæ and known locally as "Tharapu."

Flowers of *Pergularia odoratissima*, Sm., a tree belonging to the N.O. Asclepiadacea and found in Hawaii. It is there known as "Chinese Violet" or "Pakalang" and the odour is sometimes extracted by greases.

Flowers of *Securidaca longepedunculata*, a tree of the N.O. Polygalaceæ, found growing in S.W. Africa, where it is known as the "Violet Tree."

Natural Perfume.—In the south of France violets are cultivated for their perfume at Vence, Le Rouret, Opio, Roquefort, Valboune, Le Bar, Tourettes-sur-Loup, Magagnosc, and Chateauneuf. At Grasse [2] the quantities produced have been getting less during recent years and have

[1] "Les Parfums de France," 13 (1924), 29. [2] *Ibid.*, 27.

now practically disappeared. The total French crop of Victoria violets before the war was about 130,000 kg., and this has now fallen to about 60,000 kg., of which only 20,000 kg. are used in perfumery. A larger crop of Parma violets is, however, available for this purpose, and it at present averages 50,000 kg. The quantity of wood violets, Czar, Prince of Wales, and Wilson, has so diminished as to be practically negligible. The propagation of the violet is by means of runners, stolons, seeds, and by separation of tufts. The suckers are separated from the parent plant towards the end of the winter or the early spring. They are planted out in rows about 2 feet apart, a space of 10 or 12 inches separating each plant. About mid-summer the lower parts are banked up to preserve them, and in October they are transplanted to the olive groves which affords the best protection from the cold in winter and the sun in summer. The ground is previously well manured with sodium nitrate 4, superphosphate 6, potassium chloride 3, and subsequently furrowed. The leaves appear in profusion by November, and the flowers bloom from early December onwards to sometimes as late as March or April; this, of course, being dependent on atmospheric conditions. The flowers and leaves are picked separately twice a week in the morning, and no time is wasted in transporting them to the factories for immediate treatment; a considerable part of their fragrance is lost if any delay occurs. Beds of Parma violets require four years to become commercially productive and Victoria violets two years. After six or seven years the plants become exhausted and are replaced. The flowers are extracted by maceration or by volatile solvents, and the absolutes from either of the resultant products are exceptionally expensive. It is rather remarkable that the yield from both types of violets and their leaves is approximately the same. Some 4000 flowers weigh one kilo and the yield to petroleum ether is about 0·12 per cent of Parma concrete and 0·18 per cent of Victoria concrete, both varieties giving some 35 to 40 per cent of absolute.

The concretes are green waxy materials having a comparatively weak odour, recalling both orris and carnation. Quite recently Sabetay and Trabaud [1] treated Parma violet concrete by steam distillation *in vacuo* and obtained a perfume content of 11·7 per cent. By the same means the absolute gave 32·7 per cent. Violet leaves yield to volatile solvent extraction 0·57 per cent of concrete giving 66 per cent of absolute. Owing to the astronomic price of Parma violet absolute—about 200 francs a gram—it is very doubtful if any *absolutely pure* absolute is ever sold. Victoria violets are, by the way, much used in the manufacturing of confectionery.

Chemistry.—Until recently very little was known as to the constituents of violet flowers, and particularly of Parma violets, although violet leaves had been well studied from a chemical viewpoint. The absolute from the latter is characterised by a well-known intensely green odour, the main constituent being nonadienal which occurs to the extent of from 30 to 50 per cent. In addition the following are present: normal hexenic, heptenic and octenic alcohols, nonadeine-2, 6-ol-1, hexyl and benzyl alcohols, and n-octene-2-ol-1 in the free state or in the form of propionic, oenanthic, octanoic, octenoic, palmitic and salicylic esters.

In view of the disagreement between the results of the chemical examination of violet flowers by H. von Saden,[2] H. Walbaum and A. Rosenthal,[3] Mr. Fred Firmenich of the well-known firm of Naef in Geneva arranged for the preparation in Grasse of 700 grams of guaranteed pure absolute from Victoria violets. This oil was subjected by Dr. Ruzicka [4] and his co-workers to various tests for phthalic acid esters, violet leaf absolute, etc., all of which were

[1] "P. and E.O.R." (1940), 50.
[2] "Journ. f. prakt. Chem.," II. T. 69, p. 261 (1904),
[3] Schimmel's "Report," August (1929), p. 191.
[4] "Congress of Industrial Chemistry," Paris, 1937.

negative, thus corroborating the purity of the product. Other alcohols in addition to nonadienal and benzyl alcohol were found in the violet flower absolute, amongst them n-hexyl alcohol, together with heptenol and octadienol, thus proving that the flower oil contains a number of alcohols closely identical to those in violet leaf. From olfactory tests it was quite evident that these various bodies were not the osmophores responsible for the odour that distinguishes violet flower oil. The true bearer of the characteristic odour of the flower perfume was not discovered until the Reagent T[1] of H. Girard became available. By means of this reagent, Ruzicka was able to isolate a ketone which, even in very dilute solutions, had a strong resemblance to violet flowers. Empirical analysis established the formula $C_{13}H_{20}O$ for this new ketone.[2] Numerous tests demonstrated that this was a new isomer of the ionones, found only in violet flowers and absent from the leaves. The name *Parmone*[3] was given to this ketone, which is now synthesised in the Naef laboratories and is available in a compounded form as Parmantheme.

In their study of Parma violet absolute,[4] Sabetay and Trabaud noticed its marked peppery odour and, according to their exhaustive tests, were able to prove the presence of 21 per cent of eugenol. They searched for this phenol in the absolute from violet leaves but only found trifling quantities recognisable by its odour. They did, however, find a high methoxy content which had hitherto escaped all investigations.

Violet roots when freshly bruised emit a fragrant smell, and since the presence of a volatile oil was suspected an examination was made by Goris and Veschniac.[5] They

[1] Trimethyl carbohydrazidomethyl ammonium chloride.

[2] Irone is $C_{14}H_{22}O$.

[3] From the 700 grams of Victoria violet absolute, Dr. Ruzicka was only able to isolate 0·25 gram of this ketone.

[4] "P. and E.O.R." (1940), 50.

[5] "Bulletin" of Roure-Bertrand Fils, 1921 (4), 33.

were able to show that methyl salicylate was probably present.

Compounding Notes.—The basis of all artificial violet oils is ionone, and for good results it should be as pure as possible and free from citral and acetone. The difference in odour value of the alpha and beta is quite noticeable to the practised user, and very different results can be obtained with each isomer. Of the two, alpha is most generally used as it is altogether more fragrant, although numerous shades of violet perfume are obtainable by the addition of varying quantities of beta. Methyl ionone is usually blended with either of the above ketones and possesses an odour which is softer. The total quantity of ionones in a synthetic violet should not exceed 50 per cent. The odour of ionone lacks "body," and the art in its use lies in being able to back it so that it does not lose any of its freshness in a compound. For this purpose there is nothing better than concrete orris oil, plus some benzyl iso-eugenol. The quantities used should be added to the ionone and allowed to blend for some weeks; in fact it is advisable, where possible, to keep a stock mixture so that the final blend will not require such long maturing. When benzyl iso-eugenol is not available, heliotropin may be used instead, but the resulting perfume will not be so fine, and smaller proportions are necessary if the odour of the latter body is to be completely covered. Another necessary ingredient which we may legitimately classify as "basic," is methyl octine carbonate. This body, often called vert de violette, is used to impart the fresh leafy effect at all times so desirable in violet perfumes. Natural violet-leaf absolute (colourless) will, of course, produce oils of truer odour and is an imperative constituent in all high-grade products. This may be used up to about 3 per cent, while the former should not exceed 2 per cent, and usually half the amount will suffice. These percentages will naturally depend upon whether the experimenter desires to produce a plain or "leafy" compound. The blenders and modifiers offer a wide range of choice, and the following may be taken as representative of the most useful. The synthetics include anisic aldehyde and alcohol, vanillin or eugenol and duodecy aldehyde. The first may be employed up to 2 per cent, although much less is often enough, and the last should not exceed 0·2 per cent. The natural products include both essential oils and flower extracts. The most useful bodies belonging to the former class are ylang-ylang, santalwood, and bergamot, while in the latter are found cassie, jasmin, mimosa, reseda, rose, and tuberose. Of these the first two are most necessary, and for "de luxe" products the use of some *natural* absolute is imperative. The proportions of any of them will depend entirely on the type of violet otto the perfumer has in mind, and price, of course, is a great consideration. Generally 2 per cent of cassie and 4 per cent of jasmine is about the maximum, and in the majority of cases less than this will prove effective. The fixation of pseudo-violets is not difficult, since many of the above-mentioned bodies possess distinct fixative qualities. In addition to these should be mentioned orris oleo-resin, benzoin, tolu, cistus, costus, civet, musk ketone, and vetivert.

Synthetic Components :—

Bases.—Alpha, beta, and methyl ionones.

Blenders.—Bergamot, benzyl acetate, orris concrete, terpineol, guaiac-wood oil, bois de rose oil, benzyl isoeugenol, heliotropin, hydroxyl-citronellal, eugenol.

Modifiers.—Ylang-ylang absolute and oil—Manila, methyl heptine and octine carbonates, violet leaf absolute, vanilla, anisic aldehyde, ethyl myristinate, phenylethyl acetate, amyl actylate.

Fixers.—Vetivert, santalwood, orris oleo-resin, benzoin, civet, musk ketone, vanillin, labdanum, costus, styrax.

Florales.—Violet, jasmin, cassie, mimosa, rose, reseda.

Aldehydes.—C_{12}, cuminic.

Formulæ illustrating the use of the various raw materials are given below :—

Violette Vera, No. 1104.

400	Methyl ionone.
100	Alpha ,,
100	Bergamot oil.
100	Jasmin, No. 1053.
10	Methyl octine carbonate.
50	Ylang-ylang absolute.
10	Vetivert oil—Bourbon.
25	Cassie absolute.
5	Rose otto.
1	Laurinic aldehyde.
4	Violet leaf absolute.
20	Eugenol.
25	Musk ketone.
50	Orris concrete.
30	Benzyl iso-eugenol.
70	Heliotropin.
1000	

Parma Violets, No. 1105.

100	Beta ionone.
100	Alpha ,,
250	Methyl ,,
50	Bergamot.
70	Anisic aldehyde.
150	Jasmin colourless, No. 1055.
30	Laurinic aldehyde, 10 per cent.
30	Orris concrete.
80	Manila-ylang oil.
20	Hydroxy-citronellal.
15	Methyl octine carbonate.
50	Eugenol.
10	Civette absolute.
5	Santalwood oil—E.I.
5	Cassie absolute.
5	Jasmin ,,
30	Heliotropin.

Victoria Violets, No. 1106.

500	Ionone alpha ± beta.
75	Orris oil liquid.
25	Rose otto.
10	Mimosa absolute.
40	Benzyl acetate.
40	Rhodinol.
100	Cassie, No. 1025.
200	Violettophyx, No. 1010
10	Musk ketone.
1000	

Wood Violets, No. 1107.

500	Ionone beta, 100 per cent.
20	Violet leaf absolute.
5	Aldehyde C_{12}.
5	Oakmoss resin.
20	Cananga oil—terpeneless.
60	Santalol.
40	Benzyl acetate.
150	Violettophyx, No. 1010.
100	Heliotropin.
100	Orris oil concrete.
1000	

Rhine Violets, No. 1108.

400	Ionone alpha.
100	Linalyl acetate.
100	Rhodinol.
70	Irone.
20	Methyl heptine carbonate.
80	Terpineol.
50	Orris resin
50	Guaiac-wood oil.
100	Violettophyx, No. 1010.
30	Vanillin.

Alcoholic Perfumes may be prepared from the compounds above described as follows :—

No. 1109.

80	Parma violets, No. 1105.
5	Cassie absolute.
2	Violet ,,
2	Jasmin ,,
1	Rose ,,
10	Musk extract, 3 per cent.
900	Alcohol.
1000	

WALLFLOWER.

The Plant.—*Cheiranthus cheiri*, popularly known as the giroflée, is a perennial plant of the N.O. Cruciferæ and native of Southern Europe. It was well known to the ancient Greeks, and is mentioned by Theophrastus (400 B.C.) in his "Enquiry into Plants." The wallflower was introduced to this country nearly 400 years ago, and is now one of the commonest plants cultivated in our gardens. It is the flower with which romance-writers embellish their stories relating to ruins and desolate places. "From the fact that wallflowers grew upon walls and were seen on casements and battlements of ancient castles and among the remains of abbeys, the minstrels and troubadours were accustomed to wear a bouquet of these flowers as the emblem of an affection which is proof against time and misfortune."[1] The plant seldom exceeds a foot in height, and in the natural state the flowers are single and of a yellowish colour. Cultivation has produced various beautifully coloured specimens, and many acres of them are grown to supply the London markets. The parent plant was called at one time the "forty-day wallflower" because it often blossomed 40 days after sowing. These should not

[1] D. McDonald, "Fragrant Flowers and Leaves" (1895), 23.

be confused with the alpine wallflower, the fairy, and the rhoetian wallflower, which belong to the genus *Erysimum*.

Chemistry.—The natural perfume is not an article of commerce. The flowers were extracted by E. Kummert[1] with volatile solvents, and after removal of natural waxes, etc., he obtained 0·06 per cent of an oil of disagreeable odour. This chemist established the presence of the following constituents :—

Irone	Salicylic acid
Nerol	Anthranilic acid
Geraniol	Methyl anthranilate
Benzyl alcohol	Indole
Anisic aldehyde	Acetic acid
Linalol	and traces of phenols and lactones.

Compounding Notes.—The synthetic otto is compounded on the lines of the analysis given above, using a mixture of geraniol, linalol, anisic aldehyde, and benzyl alcohol as the basis of the perfume. The blenders and modifiers consist of phenylethyl phenylacetate, hydroxy-citronellal, methyl anthranilate, and heliotropin, while the characteristic wallflower note is obtained with *p*-cresyl methyl ether. Indole and decyl aldehyde are useful additions, but the former is now replaceable by amyl cinnamic aldehyde. Rose with traces of cassie supply the flowery touch, and fixation is completed with benzoin, Peru balsam, or benzyl iso-eugenol. The green by-odour characteristic of many wallflowers may be reproduced with methyl heptine carbonate or phenylacetic aldehyde.

Synthetic Components :—

Bases.—Anisic aldehyde, benzyl alcohol, geraniol, linalol, *p*-cresyl methyl ether.

Blenders. — Methyl anthranilate, nerol, petitgrain, hydroxy-citronellal, phenylethyl phenylacetate, bergamot oil.

[1] "Chem. Ztg.," 35 (1911), 667, through Gildemeister and Hoffmann, "Volatile Oils," II, 533.

[*Sutton & Sons.*

FIG. 81.—Wallflowers.

[*To face page* 264.

Modifiers.—Methyl heptine carbonate, phenylacetic aldehyde, ionones, eugenol, geranyl acetate, cinnamyl acetate, ylang, heliotropin.

Fixers.—Benzyl iso-eugenol, Peru balsam, benzoin, ketone musk.

Florales.—Rose, cassie, jonquille, jasmin, tuberose.

Aldehydes.—C_{10} and amyl cinnamic.

Formulæ follow :—

Wallflower, No. 1110.

200	Geraniol from palmarosa oil.
50	Linalol.
200	Anisic aldehyde.
100	Benzyl alcohol.
10	Methyl anthranilate.
80	Hydroxy-citronellal.
2	Para-cresyl methyl ether.
5	Amyl cinnamic aldehyde.
2	Methyl heptine carbonate.
1	Aldehyde C_{10}.
50	Cassie, No. 1025.
100	Rose, No. 1091.
50	Benzoin R.
50	Benzyl iso-eugenol.
100	Heliotropin.
1000	

Alcoholic Perfumes may be prepared as follows

No. 1111.

80	Wallflower, No. 1110.
5	Tuberose absolute.
5	Jasmin ,,
10	Musk extract, 3 per cent.
900	Alcohol, 90 per cent.
1000	

CHAPTER VII.

MISCELLANEOUS FANCY PERFUMES.

1. Non-Alcoholic Concentrates.
2. Well-known Recipes.
3. Continental Practice.

NON-ALCOHOLIC CONCENTRATES.

UNDER this heading are included formulæ which after maturing will be found useful for perfuming all kinds of toilet articles. In the event of their being required for perfuming brilliantines, etc., where turbidity would result on mixation, the essential oils should be replaced by their *terpeneless* equivalents and the natural absolutes by their *artificial* imitations.

Abronia, No. 1112.

500	Verbena oil—French.
50	Rhodinol.
50	Irone.
20	Iso-eugenol.
80	Heliotropin.
40	Rose, No. 1090.
130	Bergamot oil.
30	Musk ketone.
50	Neroli synthetic.
40	Benzoin R.
10	Cistus R.
1000	

Alyxia, No. 1113.

500	Benzyl acetate.
100	Cinnamic alcohol.
100	Benzyl "
40	Rose absolute.
50	Jasmin, No. 1053.
10	Aldehyde C_{10}, 10 per cent solution.

100	Hydroxy-citronellal.
50	Iso-butyl phenylacetate.
20	Styrax R.
30	Ethyl phthalate.
1000	

Ambre Royale Aux Fleurs, No. 1114.

5	Diphenyl methane.
5	Vetivert oil—English.
5	Clary sage oil.
10	Jasmin absolute.
25	Violet, No. 1105.
25	Santalwood oil—English.
25	Coumarin.
50	Musk ketone.
50	Heliotropin.
50	Hydroxy-citronellal.
50	Iso-butyl phenylacetate.
50	Rose oil—Bulgarian.
50	Ambrone, No. 1007.
50	Musk extract, 3 per cent.
50	Benzoin R.
250	Benzyl benzoate.
250	Ambergris extract, 3 per cent.
1000	

Ambrosia, No. 1115.

100	Coumarin.
20	Dimethyl hydroquinone.
20	Oakmoss colourless.
300	Iso-butyl salicylate.
10	Methyl naphthyl ketone.
200	Bergamot oil—terpeneless
200	Lavender oil—English.
20	Ionone beta.
5	Diphenyl oxide.
25	Ylang-ylang oil.
50	Jasmin, No. 1055.
50	Iso-butyl benzoate.
1000	

Benzoinette, No. 1116.

5	Ethyl cinnamate.
5	Anisic aldehyde.
100	Vanillin.
50	Coumarin.
100	Tuberose, No. 1101
200	Rose, No. 1092.
20	Vetivert oil.
10	Patchouli oil.
10	Oakmoss resin.
100	Benzyl iso-eugenol.
400	Benzoin R.
1000	

Boronia, No. 1117.

200	Bergamot oil—terpeneless.
50	Lemon oil.
200	Rose Centifolia, No. 1091.
10	Clary sage oil.
90	Neroli, No. 1081.
50	Tuberose, No. 1101.
50	Heliotropin.
50	Muguet, No. 1063.
200	Ambrone, No. 1007.
100	Boronia absolute.
1000	

Bouquet Des Alpes, No. 1118.

400	Lavender oil—French.
100	Bergamot oil.
100	Geraniol.
5	Ambrette oil.
25	Ylang-ylang oil.
5	Clary sage oil.
25	Rosemary oil.
50	Jasmin absolute—chassis.
200	Benzoin R.
90	Ethyl phthalate.
1000	

Bouvardia, No. 1119.

80	Benzyl propionate.
20	Benzyl iso-butyrate.
100	Benzyl acetate.
80	Cinnamic alcohol.
130	Cedrat oil.
20	Methyl anthranilate.
200	Hydroxy-citronellal.
50	Alpha ionone.
100	Linalol.
70	Phenylethyl phenylacetate.
20	Undecylic aldehyde, 10 per cent.
30	Jasmin absolute.
10	Rose ,,
10	Tuberose absolute.
50	Para-cresyl phenylacetate.
30	Heliotropin.
1000	

Cananga, No. 1120.

50	Jasmin, No. 1055.
50	Meta-cresyl phenylacetate.
20	Iso-eugenol.
30	Phenylethyl formate.
50	Neroli, No. 1081.
100	Jonquille, No. 1074.
675	Cananga oil—terpeneless.
25	Alcohol C_{10}.
1000	

Coronilla, No. 1121.

200	Hydroxy-citronellal.
150	Amyl phenylacetate.
100	Coumarin.
100	Dimethyl hydroquinone.
100	Jasmin, No. 1053.
50	Diphenyl methane.
100	Rose, No. 1090.
200	Ambrone, No. 1007.
1000	

Corylopsis, No. 1122.

300	Ylang-ylang oil—Manila.
250	Benzyl acetate.
15	Heliotropin.
130	Rose, No. 1090.
50	Patchouli R.
5	Vetiverol.
100	Hydroxy-citronellal.
150	Benzoin R.
1000	

Decumaria, No. 1123.

500	Anisic aldehyde.
25	Para-methyl acetophenone.
100	Heliotropin.
75	Vanillin.
5	Aldehyde C_{16}, 10 per cent solution
95	Benzyl acetate.
75	Petitgrain oil—terpeneless.
25	Geranyl formate.
100	Benzyl iso-eugenol.
1000	

Dillenia, No. 1124.

250	Terpineol.
100	Rhodinol.
250	Bergamot oil.
50	Cassie, No. 1025.
50	Orange blossom absolute.
30	Heliotropin.
20	Musk ketone.
250	Violettophyx, No. 1010.
1000	

Erica, No. 1125.

40	Diphenyl oxide.
30	Oakmoss resin.
200	Bergamot oil—terpeneless
100	Benzyl iso-eugenol.
30	Dimethyl hydroquinone.
50	Oleo-resin orris.
150	Amber liquid, No. 1005.
200	Geraniol.
150	Citronellol.
50	Coumarin.
1000	

Fagonia, No. 1126.

300	Terpineol.
250	Linalol.
150	Hydroxy-citronellal.
60	Ylang-ylang oil.
50	Jasmin, No. 1055.
140	Geraniol.
20	Vanillin.
30	Civet extract, 3 per cent.
1000	

Glycine, No. 1127 (Wistaria)

180	Hawthorn, No. 1037.
50	Eugenol.
100	Methyl ionone.
100	Hydroxy-citronellal.
70	Ylang oil—Bourbon.
80	Rose centifolia, No. 1091
190	Jasmin, No. 1055.
100	Terpineol.
40	Coumarin.
60	Heliotropin.
30	Musk ketone.
1000	

Hancornia, No. 1128.

180	Jasmin, No. 1053.
100	Tuberose, No. 1101.
50	Rose, No. 1091.
20	Cassie, No. 1025.
200	Benzyl propionate.
350	Hydroxy-citronellal.
25	Dimethyl hydroquinone.
25	Clary sage oil.
50	Styrax R.
1000	

Hugonia, No. 1129.

100	Heliotropin.
50	Vanillin.
250	Ionone alpha.
50	Orris oil—concrete.
25	Cassie absolute.
25	Jasmin ,,
3	Aldehyde C_{12}.
47	Santalwood oil.
100	Tolu R.
50	Cistus R.
50	Musk ketone.
250	Benzoin R.
1000	

Idealia, No. 1130.

100	Bergamot oil.
50	Sweet orange oil.
80	Methyl ionone.
20	Ylang oil—Manila.
100	Carnation, No. 1021
100	Chypre, No. 1029.
20	Cassie absolute.
10	Neroli oil.
170	Jasmin, No. 1055.
150	Rose, No. 1092.
50	Coumarin.
40	Heliotropin.
60	Vanillin.
50	Amyl salicylate.
1000	

Ismene, No. 1131.

500	Muguet, No. 1063.
100	Ylang-ylang oil.
50	Jasmin absolute.
50	Tuberose ,,
25	Vanillin.
75	Rhodinol.
50	Olibanum R.
50	Opoponax R.
2	Undecalactone.
98	Roseophyx, No. 1008.
1000	

Jonesia, No. 1132.

150	Bergamot oil—terpeneless
30	Lemon oil—terpeneless.
20	Lime oil—terpeneless.
100	Verbena oil—terpeneless.
100	Neroli oil—bigarade.
200	Bois de rose oil.
200	Terpineol.
30	Elemi R.
30	Myrrh R.
20	Benzyl formate.
20	Geranyl ,,
100	Benzoin R.
1000	

Kleinhovia, No. 1133.

25	Mimosa absolute.
50	Cassie ,,
25	Reseda ,,
50	Orange blossom absolute
50	Jasmin absolute.
300	Violet, No. 1105.
200	Rose rouge, No. 1092.
50	Duodecyl alcohol.
50	Concrete orris.
200	Heliotropin.
1000	

Lælia, No. 1134.

200	Iso-butyl salicylate.
300	Amyl salicylate.
25	Oakmoss absolute.
25	Labdanum R.
150	Coumarin.
20	Dimethyl hydroquinone.
180	Linalyl acetate.
50	Lavender oil.
5	Tarragon oil.
5	Methyl heptine carbonate.
40	Iso-butyl phenylacetate.
1000	

Lime Blossom, No. 1135.

400	Hydroxy-citronellal.
150	Terpineol.
180	Phenylethyl alcohol.
20	Ylang oil—Bourbon.
10	Limes oil—terpeneless.
50	Methyl naphthyl ketone.
30	Jasmophore.
70	Citronellyl acetate.
5	Methyl octine carbonate.
10	Iso-butyl phenylacetate.
5	Aldehyde C_{12}.
20	Jasmin absolute.
10	Broom ,,
30	Heliotropin.
10	Musk ambrette.
1000	

Monimia, No. 1136.

300	Grasse geranium oil—terpeneless
200	Ylang-ylang oil.
100	Heliotropin.
100	Vanillin.
25	Iso-eugenol.
50	Jasmin, No. 1053.
50	Patchouli oil.
25	Oakmoss resin.
30	Rose absolute.
20	Orange flower absolute.
100	Benzyl benzoate.

Nemesia, No. 1137.

125	Methyl ionone.
100	Rose rouge, No. 1092.
75	Cistus R.
100	Bergamot oil—terpeneless.
100	Jasmin colourless, No. 1055
50	Heliotropin.
50	Coumarin.
40	Musk ketone.
260	Amber liquid, No. 1004.
80	Linalol.
20	Meta-cresol phenylacetate.
1000	

Night Scented Stock, No. 11

100	Mimosa, No. 1069.
100	Jasmin, No. 1053.
100	Methyl ionone.
150	Citronellol.
100	Geraniol.
50	Bois de rose oil.
50	Bergamot.
100	Terpineol.
20	Ylang Bourbon oil.
20	Orris concrete.
10	Jasmin absolute.
10	Coumarin.
70	Iso-eugenol.
120	Heliotropin.
1000	

Opoponax, No. 1139.

400	Bergamot oil.
70	Rhodinyl acetate.
80	Santalwood oil—English.
30	Citral.
50	Musk ambrette.
50	Heliotropin.
100	Vanillin.
30	Vetivert oil—English.
20	Patchouli oil.
70	Benzoyl acetone.
100	Benzoin R.
1000	

Opoponax, No. 1140.

300	Bergamot oil—terpeneless.
50	Orris oil concrete.
50	Opoponax R.
20	Lemon oil—terpeneless.
50	Jasmin extra, No. 1053.
80	Rose rouge, No. 1092.
10	Ginger oil.
50	Myrrh R.
40	Galbanum R.
25	Encens R.
50	Violet, No. 1105.
25	Vetivert oil.
50	Cistus R.
200	Ambrone, No. 1007.
1000	

Passiflora, No. 1141.

370	Amber liquid, No. 1004.
100	Coumarin.
100	Heliotropin.
200	Hydroxy-citronellal.
5	Undecalactone.
100	Dimethyl hydroquinone.
100	Iso-butyl phenylacetate.
25	Clary sage oil.
1000	

Pavetta, No. 1142.

40	Vetivert oil—English.
60	Patchouli oil—English.
100	Santalwood oil.
200	Rose geranium oil.
25	Musk extract, 3 per cent.
25	Civet ,, ,,
100	Benzyl iso-eugenol.
100	Coumarin.
50	Heliotropin.
200	Bois de rose oil.
100	Benzoin R.
1000	

Randia, No. 1143.

400	Benzyl acetate.
200	Hydroxy-citronellal.
50	Phenylacetic aldehyde.
50	Ylang-ylang oil.
100	Linalol.
10	Aldehyde C_9.
40	Alcohol C_{10}.
50	Cinnamyl cinnamate.
100	Cinnamic alcohol.
1000	

Santolina, No. 1144.

400	Lavender oil—French.
100	Bergamot oil.
75	Ylang-ylang oil.
25	Clary sage oil.
10	Oakmoss absolute.
40	Ambrette R.
50	Vetivert R.
50	Cassie, No. 1025.
150	Rose, No. 1090.
100	Benzoin R.
1000	

Stephanotis, No. 1145.

250	Heliotropin.
250	Phenylethyl acetate.
25	Para-cresyl phenylacetate
40	Coumarin.
60	Rhodinol.
25	Musk ambrette.
10	Civet extract, 3 per cent.
30	Cassie absolute.
30	Jasmin ,,
30	Jonquille ,,
50	Tuberose ,,
200	Ambrone, No. 1007.
1000	

Syringa, No. 1146.

250	Hydroxy-citronellal.
100	Terpineol.
50	*p*-methyl phenylacetaldehyde.
100	Anisic aldehyde.
200	Jasmin extra, No. 1053.
100	Orange blossom, No. 1082.
10	Acetophenone.
90	Cinnamic alcohol.
100	Heliotropin.
1000	

Tinnea, No. 1147.

50	Duodecyl alcohol.
50	Ethyl decine carbonate
100	Irone.
200	Methyl ionone.
100	Benzyl iso-eugenol.
100	Santalwood oil.
100	Ylang-ylang oil.
50	Musk ketone.
50	Vanillin.
200	Rose, No. 1092.
1000	

WELL-KNOWN RECIPES.

The following formulæ represent the approximate equivalent, expressed in terms of *Absolute flower oil*, for many popular alcoholic handkerchief perfumes, recipes for which have been published.

Experiment will show the proportion of spirit required for their dilution.

À la Mode, No. 1148.

45	Benzaldehyde.
35	Nutmeg oil—expressed.
120	Cassie, No. 1025.
320	Jasmin, No. 1053.
220	Orange blossom, No. 1082.
220	Tuberose, No. 1101.
40	Civet extract, 3 per cent.
1000	

Bouquet des Fleurs, No. 1149.

240	Bergamot oil.
120	Lemon oil.
120	Portugal oil.
150	Violet, No. 1105.
150	Tuberose, No. 1101.
150	Rose, No. 1092.
70	Benzoin R.
1000	

Bouquet d'Esterhazy, No. 1150.

250	Neroli, No. 1081.
250	Orange flower, No. 1082.
250	Rose, No. 1091.
50	Clove oil.
50	Santalwood oil.
40	Coumarin.
10	Vanillin.
10	Vetivert oil—English.
40	Concrete orris.
50	Ambrone, No. 1007.
1000	

Buckingham Flowers, No. 1151.

200	Rose, No. 1090.
200	Jasmin, No. 1055.
200	Cassie, No. 1025.
200	Orange flower, No. 1082.
50	Concrete orris.
50	Rose otto—Bulgarian.
30	Neroli oil petale.
30	Lavender oil—English.
40	Amber liquid, No. 1006.
1000	

Essence Bouquet, No. 1152.

160	Petitgrain oil.
160	Sweet orange oil.
140	Rose, No. 1092.
130	Jasmin, No. 1054.

Essence Bouquet, No. 1152 (*continued*).

120	Lavender oil—French.
80	Lemon oil.
80	Neroli, No. 1081.
25	Rose oil—Bulgarian.
25	Thyme oil—white.
20	Palmarosa oil.
20	Clove oil.
20	Cassia oil.
20	Musk extract, 3 per cent.
1000	

Eau de Berlin, No. 1153.

150	Aniseed oil.
480	Bergamot oil.
20	Cardamon oil.
15	Coriander oil.
30	French geranium oil.
30	Lemon oil.
20	Melissa oil.
75	Neroli oil.
40	Rose oil—Bulgarian.
30	Santalwood oil.
20	Thyme oil—white.
90	Ethyl phthalate.
1000	

Frangipanni, No. 1154.

60	Bergamot oil.
200	Cassie, No. 1025.
50	Civet extract, 3 per cent.
80	Geranium oil—French.
50	Musk extract, 3 per cent.
72	Neroli oil.
120	Orange blossom, No. 1082.
40	Rose otto.
200	,, No. 1092.
10	Santalwood oil.
60	Coumarin.
58	Vanillin.
1000	

Horse-Guard's Bouquet, No. 1155.

700	Rose, No. 1091.
150	Orange flower, No. 1082.
60	Iso-eugenol.
30	Concrete orris.
20	Vanillin.
40	Musk ambrette.
1000	

Hovenia, No. 1156.

340	Iso-eugenol.
210	Lemon oil—terpeneless.
225	Petitgrain oil—terpeneless
225	Rose, No. 1092.
1000	

Japanese Bouquet, No. 1157.

160	Cedarwood oil.
160	Patchouli oil.
160	Santalwood oil.
160	Verbena oil—French.
80	Vetivert oil.
280	Rose—Provence, No. 1091.
1000	

Jockey Club, No. 1158.

160	Bergamot oil—super.
200	Jasmin, No. 1053.
300	Rose, No. 1092.
140	Tuberose, No. 1101.
160	Mace oil—concrete.
40	Civet extract, 3 per cent.
1000	

Kiss Me Quick, No. 1159.

200	Cassie, No. 1025.
50	Amber liquid, No. 1005.
400	Jonquille, No. 1074.
10	Para-cresyl phenylacetate.
20	Coumarin.

Kiss Me Quick, No. 1159 (*continued*).

20	Orris resin.
40	Civet extract, 3 per cent.
200	Rose, No. 1092.
40	Citronella oil.
20	Lemon-grass oil.
1000	

Leap-Year Bouquet, No. 1160.

300	Jasmin, No. 1053.
20	Patchouli oil.
150	Santalwood oil.
200	Tuberose, No. 1101.
30	Verbena oil—French.
150	Vetivert oil—Java.
150	Rose, No. 1092.
1000	

Bouquet a la Maréchale, No. 1161

100	Neroli oil—bigarade, extra.
200	Orange blossom, No. 1092.
80	Coumarin.
80	Vanillin.
80	Orris oil concrete—Florentine.
100	Vetivert oil.
200	Rose, No. 1092.
40	Clove oil.
40	Santalwood oil.
40	Musk extract, 3 per cent.
40	Ambrone, No. 1007.
1000	

Millefleur Bouquet, No. 1162.

60	Cassie absolute.
60	Cedarwood oil.
80	Jasmin extra, No. 1053.
60	Neroli oil—bigarade.
60	Patchouli oil.
60	Vanillin.
60	Violet, No. 1105.
60	Vetivert oil.

80	Lemon oil.
120	Rose geranium oil.
120	Lavender oil—French.
80	Sweet orange oil.
50	Musk extract, 3 per cent.
50	Civet ,, ,, ,,
1000	

Musk, No. 1163.

200	Musk ambrette.
200	,, ketone.
50	Ionone beta.
50	Vetivert oil—terpeneless.
100	Santalwood oil.
400	Benzyl benzoate.
1000	

Mousseline, No. 1164.

150	Cassie, No. 1025.
150	Jasmin, No. 1053.
150	Rose de Provence, No. 1091.
150	Tuberose, No. 1101.
200	Bouquet à la maréchale, No. 1161.
200	Santalwood oil—E.I.
1000	

Polyanthus, No. 1165.

300	Rose, No. 1092.
150	Jasmin, No. 1053.
75	Violet, No. 1105.
200	Neroli, No. 1081.
200	Lemon oil.
75	Musk extract, 3 per cent.
1000	

Rondeletia, No. 1166.

10	Basil oil.
120	Bergamot oil.
250	Lavender oil.

Rondeletia, No. 1166 (*continued*)

50	Clove oil.
20	Rose oil—Bulgarian.
300	Santalwood oil.
40	Geranium oil—French.
40	Cinnamon leaf oil.
10	Ambrette oil.
20	Orris oil concrete.
10	Jasmin absolute.
10	Tuberose ,,
70	Ambrone, No. 1007.
20	Vanillin.
30	Musk ketone.
1000	

Tulip, No. 1167.

40	Cassie, No. 1025.
260	Jasmin, No. 1055.
135	Rose, No. 1092.
260	Tuberose, No. 1101.
260	Orris concrete.
15	Benzaldehyde.
30	Neroli, No. 1081.
1000	

Yacht Club, No. 1168.

200	Orange blossom, No. 1082.
100	Jasmin extra, No. 1053.
20	Cassie, No. 1025.
200	Santalwood oil.
50	Vanillin.
100	Rose de Mai, No. 1091.
330	Benzoin R.
1000	

CONTINENTAL PRACTICE.

The following formulæ have been extracted from the works of the authors quoted, the same odour types being chosen so that comparisons may the more easily be made. Prior to 1912 the books published contained very few formulæ utilising synthetics, and are therefore omitted. The formulæ numbers have been appended by the author.

1912. H. Mann, "Die Moderne Parfumerie."

Chypre, No. 1169.

00	Spirit.
00	Infusion tolu balsam.
00	,, Peru ,,
00	,, storax.
00	Tincture musk.
10	Turanol.
50	Solution orris oil.
00	,, vetivert oil
5	Wintergreen oil.
20	Aubepine.
00	Bergamot.
5	Citral.
00	Lemon oil.
5	Benzyl acetate.
50	Geranium oil.
20	Lavender oil.
5	Eugenol.
30	Cedarwood oil

Lilac (Persian), No. 1170.

7000	Tincture jasmin 15 : 1000.
5000	,, tuberose.
5000	,, rose.
200	Terpineol.
30	Cananga oil.
150	Infusion musk.
30	Linalol.
20	Vanillin.
50	Muguet (Schimmel).
150	Infusion benzoin.
20	Viodoran.
17,650	

1912. R. Cerbelaud, "Formulaire de Parfumerie et de Pharmacie."

Chypre, No. 1171.

200	Infusion oakmoss.
300	„ musk.
25	civette.
100	tuberose concrete, 2 per cent.
100	jasmin „ „ „
100	orange blossom „ „
200	orris, 20 per cent.
1025	

Lilac (white), No. 1172.

15	Terpineol.
1	Vanillin.
1	Musk ambrette.
1	Ylang oil—Manila.
2	Benzyl acetate.
1	Linalol.
1	Ionone.
1	Cananga oil.
25	Infusion ambrette seeds, 20 per cent.
1000	Alcohol.
1048	

1918. R. M. Gattefossé, "Agenda du Chemiste-Parfumeur."

Chypre Imperial, No. 1173.

10	Essence naturelle rose de Mai.
5	„ „ violet.
5	„ „ cassie.
5	„ „ orange flower.
5	„ „ tuberose.
1	„ „ orris concrete.
5	„ „ sauge sclarée.
10	„ „ mousse Evernia.
12	Sassafras oil—terpeneless.
5	Santalwood oil.
10	Bergamot oil.
2	Bois de rhodes oil.
1	Clove oil.
1	Canella oil—Chinese.

0·1	Aniseed oil.
10	Ambrette oil concrete.
10	Rose synthetic.
10	Vanillin.
5	Coumarin.
5	Violet synthetic.
117	

Lilac (white), No. 1174.

600	Terpineol.
150	Hydroxy-citronellal.
50	Vanillin.
20	Musk ketone.
100	Benzoin resinodor.
80	Jasmin absolute.
1000	

I. Lazennec, "Manuel de Parfumerie.'

Chypre, No. 1175.

300	Tincture musk artificial, 0·7 per cent.
2·5	Geraniol.
100	Tincture ambrette seeds $\frac{1}{15}$.
250	,, tonka beans $\frac{1}{10}$.
150	,, vanilla $\frac{1}{10}$.
150	,, orris.
50	Alcohol.
1002	

Lilac (white).

Duplicate of Cerbelaud.

1923. J. P. Durvelle, "Nouveau Formulaire des Parfums et des Cosmetiques."

Chypre (for export).

Duplicate of Mann, but alcohol at 12 litres 250 c.cs.

Lilac (white), No. 1176.

675	Alcohol.
5	Terpineol.
0·2	Ylang oil.
1	Neroli synthetic.
2	Jasmin essence.
1	Rose ,,
250	Infusion tuberose.
200	,, jonquille.
0·5	Ionone.
0·2	Bitter almond oil.
0·2	Clove oil.
2·5	Infusion musk.
1137	

1923. R. M. Gattefossé, "Formulaire de Savonnerie et de Parfumerie."

Chypre, No. 1177.

5	Clary sage.
30	Oakmoss.
20	Rose synthetic.
20	Violet ,,
5	Sassafras oil.
5	Vetivert oil.
3	Patchouli oil.
3	Clove oil.
10	Amber synthetic (in pieces).
20	Bergamot.
20	Coumarin.
141	

Lilac, No. 1178.

200	Hydroxy-citronellal.
250	Terpineol.
100	Tuberique alcohol.
200	Jasmin synthetic.
750	

1924. L. Cuniasse, "Memorial du Parfumeur Chimiste."

Chypre, No. 1179.

5	Ionone.
3	Civette artificial, 5 per cent.
1	Musk ambrette.

2	Geranium oil.
50	Tincture ambrette seeds.
10	„ labdanum, 50 per cent.
100	„ orris.
1	Vetivert oil.
2	Santal oil.
4	Patchouli oil.
5	Sweet orange oil.
4	Vanillin.
10	Tincture Peru balsam.
800	Alcohol.
997	

Lilac, No. 1180.

2	Neroli synthetic.
2	Rhodinol.
2	Linalyl acetate.
5	Jasmin synthetic.
25	Terpineol.
5	Tincture benzoin.
5	„ civette.
0·2	„ bitter almond oil $\frac{1}{10}$.
1	Vanillin.
1000	Alcohol.
1047	

1927. F. Winter, "Handbuch der Gesamten Parfumerie und Kosmetik."

Chypre, No. 1181.

15	Jasmin liquid, A.
5	Rose „
6	Solution orris.
6	Santal oil—E.I.
120	Bergamot.
6	Patchouli oil.
60	Musk ketone, $\frac{1}{5}$ in B.B.
5	Vetivert oil.
200	Oakmoss tincture $\frac{1}{5}$.
2	Coumarin.
1·5	Vanillin.
2	Heliotropin.
25	Rose synthetic.
10	„ otto—Bulgarian.
5	Pimento oil.

Chypre, No. 1181 (*continued*).

10	Olibanum resinoid.
4	Bitter orange oil.
2	Ambrette seed oil.
250	Musk tincture, 3 per cent.
4000	Alcohol.
4734	

Lilac, No. 1182.

500	Terpineol.
10	Ylang-ylang oil.
15	Bromstyrole.
300	Hydroxy-citronellal.
20	Jasmin synthetic.
40	Heliotropin.
3	Bitter almond oil $\frac{1}{20}$.
3	Peach lactone.
891	

1928. A. Wagner, "Die Parfumerie Industrie."

Chypre (French type), No. 1183.

1320	Solution jasmin.
1320	„ rose.
1720	„ tuberose.
1000	„ cassie.
133	Tincture musk.
33	Civette synthetic—Heiko $\frac{1}{10}$.
6·6	Calamus oil.
26	Bergamot oil.
20	Coumarin.
6·6	Patchouli oil.
6·6	Santal oil—E.I.
66	Castoreum tincture.
13	Turanol.
6·6	Iraldeine.
13	Vanillin.
666	Solution oakmoss.
6356	

Lilac, No. 1184.

300	Terpineol.
300	Guaiac-wood oil.
160	Iso-eugenol.
160	Benzyl acetate.

150	Cananga oil.
150	Amyl salicylate.
150	Phenylethyl iso-butyrate.
65	Heliotrope synthetic.
45	Ambra, A.
43	Phenylacetic aldehyde.
18	Cyclosia.
18	Lilac, No. 830.
15,000	Alcohol.
1000	Water.
17,559	

1929. H. Fouquet, "La Technique M
Formules de la Parfumerie."

Chypre, No. 1185.

25	Infusion oakmoss decolorised.
35	,, tonka beans.
45	,, orris.
20	,, olibanum.
10	,, civette.
15	,, ambrette seeds.
25	,, vanilla.
625	Extract 36, rose.
75	,, ,, cassie.
75	,, ,, jasmin.
75	,, ,, orange blossom.
10	Essence rose—Bulgarian.
15	,, geranium—terpeneless
5	,, jasmin.
5	,, santal.
5	,, neroli petales.
2	,, patchouli.
2	,, oakmoss.
4	,, vetivert.
1	,, clary sage.
3	methyl acetophenone.
1	octyl alcohol.
2	nonyl ,,
2	decyl ,,
1	octyl aldehyde.
0·5	nonyl ,,
0·5	decyl ,,
1084	

Lilac, No. 1186.

600	Extract 36, jasmin.
150	,, ,, tuberose.
100	,, ,, orange blossom.
50	,, ,, jonquille.
5	Essence jasmin.
5	,, neroli petals.
5	,, rose—Bulgarian.
5	,, ylang, extra.
15	Linalol.
15	Phenylethyl alcohol.
50	Essence lilac synthetic—H.F.
20	Infusion vanilla.
35	,, orris.
10	,, styrax.
15	,, civette.
20	Solution ,, artificial.
1	Octyl alcohol.
0·5	Nonyl ,,
0·5	,, aldehyde.
9	Amyl cinnamic aldehyde.
5	Tuberic alcohol.
1116	

1930. J. Broders, "Manuel du Parfumeur."

Chypre, No. 1187.

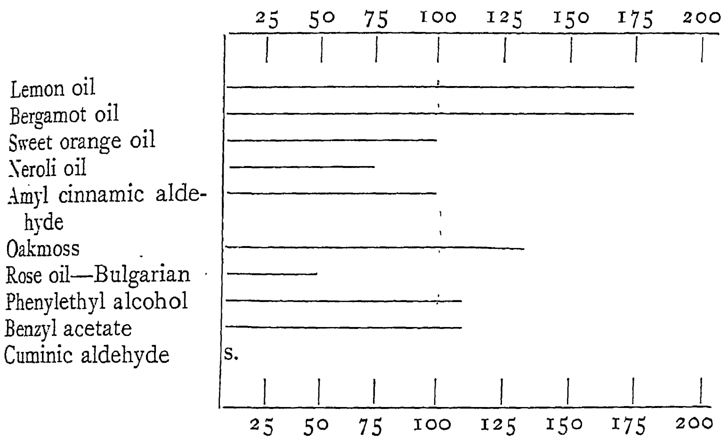
4	Infusion chypre.
2	,, à la maréchale.
2	Extract tuberose.
1	,, orange.
1	,, jasmin.
1	,, roses.
11	

Lilac, No. 1188.

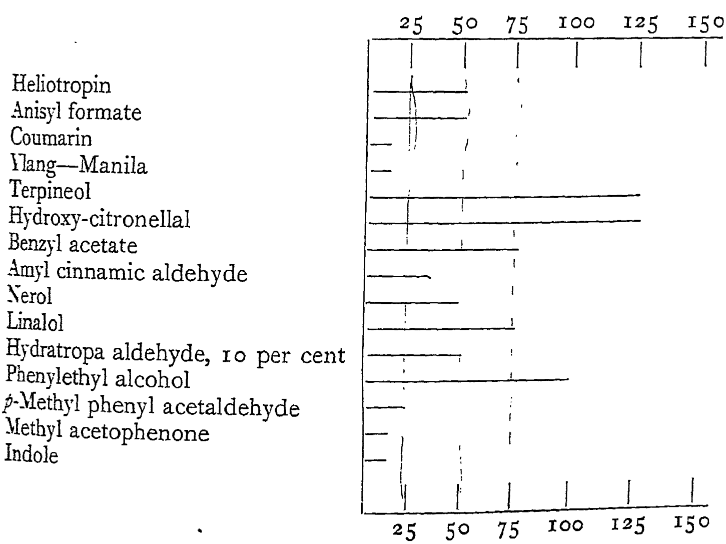
1000	Infusion vanilla.
2000	,, orris.
4000	Extract orange.
4000	,, jasmin.
2000	,, tuberose.
1000	,, cassie.
250	Infusion styrax.
10	Lemon oil.
10	Bergamot oil.
1	Bitter almond oil.

1930. A. M. Burger, "Leitfaden der Modernen Parfumerie."

Chypre, No. 1189.



Lilac Base, No. 1190.



1931. O. Gerhardt, "Das Komponieren in fumerie."

Chypre Base, No. 1191 (Coty Type).

220	Santal—E.I.
227	Bergamot oil.
50	Rose absolute.
20	Fixonal.
5	Coriander oil.
50	Jasmin synthetic.
40	Patchouli oil.
7	Red thyme oil.
110	Vetivert oil—Bourbon.
55	Labdanum resinoid.
110	Oakmoss absolute.
70	Castoreum resinoid.
20	Neroli synthetic.
1	Iso-safrole.
15	Musk ambrette.
1000	

Lilac, No. 1192.

448	Terpineol.
133	Hydroxy-citronellal.
160	Heliotropin.
50	Phenylethyl alcohol.
82	Benzyl acetate.
95	Anisaldehyde.
6	Cananga.
3	Coumarin.
6	Alpha ionone.
8	Jasmin aldehyde.
6	Dimethyl hydroquinone.
3	*p*-methoxy acetophenone.
1000	

1931. F. Cola, "Le Livre du Parfumeur."

Chypre, No. 1193.

60	Santalol.
90	Coumarin.
30	Musk ketone.
20	,, ambrette.
25	Ambreine absolute.
25	Tarragon oil.

5	Angelica root oil.
30	Clary sage.
60	Vetivert oil.
30	Linalol.
20	Patchouli oil.
35	Iso-eugenol.
50	Methyl ionone.
60	Oakmoss absolute.
225	Bergamot oil.
20	Jasmin absolute.
15	Rose ,,
2	Methyl salicylate.
3	Lavender oil.
15	Vanillin.
35	Heliotropin.
70	Ylang oil—Manila.
25	Cinnamyl acetate.
50	Benzoin resinoid.
1000	

Lilac Bouquet, No. 1194.

165	Hydroxy-citronellal.
175	Cinnamic alcohol.
155	Phenylethyl alcohol.
10	Phenylacetic aldehyde.
10	Anisic aldehyde—ex. anethol.
45	Phenol glycol acetate.
65	Heliotropin.
20	Jasmin absolute.
5	Rose ,,
5	Iso-eugenol.
5	Para-cresol—5 per cent. solution.
35	Benzyl acetate.
40	Linalol.
50	Phenylethyl acetate.
10	Cuminic alcohol.
10	Decyl alcohol—10 per cent solution.
10	Para-tolyl aldehyde—10 per cent solution.
5	Farnesol.
120	Terpineol—extra rectified.
5	Vanillin.
15	Benzyl salicylate.
45	Benzyl alcohol.
1005	

CHAPTER VIII.

TOILET WATERS.

TOILET WATERS.

FRAGRANT waters have been in use since the days of Theophrastus, and are believed to have hygienic qualities not possessed by ordinary handkerchief perfumes. It is difficult to explain their nomenclature, especially since they are generally made with weak alcohol, but, as the diluent usually consists of rose or orange flower *water*, it may be that this, to some extent at any rate, accounts for their designation.

Another distinction is, however, noticeable in nearly all modern formulæ, and this is the absence of any flower *extract*, the principal constituents being either distillation or expression products. In the formulæ which follow, it will be noticed that the *citrus* oils play an important part, even in lavender water, where the best effects are obtained by the liberal use of bergamot oil in conjunction with, of course, either English or French lavender oil.

Honey Water was probably the earliest member of this series, and is said to have been used by the ancient Greeks as a tonic for the hair. In later years it was prepared by distilling a mixture of honey, gum-arabic, and water, and was employed as a lotion for the face, which it made "white and fair." Nearly all modern formulæ are based on the product originated by George Wilson, who manufactured it for King James II. His recipe for the preparation was approximately as follows :—

No. 1195.

100	Honey.
100	Coriander fruit.
9	Cloves.
6	Nutmegs.
6	Gum benzoin.
6	Storax.
6	Vanilla pods.
10	Yellow lemon rind
243	

Bruise the cloves, nutmegs, coriander-seed, and benzoin, cut the vanilla pods in pieces, and put all into a glass alembic with a litre of French brandy, and after digesting 48 hours, distil. To one litre of the distillate add—

150	Damask rose water.
150	Orange flower water.
0·1	Musk.
0·1	Ambergris.
300	

Grind the musk and ambergris in a glass mortar, and afterwards put all together into a large matrass and let them circulate three days and three nights in a gentle heat; let them cool. Filter and keep the water in bottles well stoppered.

Honey water was popularised more recently by Sir Erasmus Wilson, who prescribed it as a hair wash. The following formula will make a pleasantly perfumed product, such as is in demand to-day :—

Aqua Mellis, No. 1196.

5	Honey.
8	Bergamot oil.
1	Lavender oil—French.
1	Clove oil.
0·5	Nutmeg oil.
1	Coriander oil.
3·5	Santalwood oil.
5	Benzoin R.
2	Musk extract, 3 per cent.
100	Rose water triple.
100	Orange flower water triple
800	Rectified spirit.
1027	

This may be prepared as described under eau de Cologne, when an excellent product will result, but if distilling apparatus is not available, the whole should be macerated at least six months and afterwards filtered.

Hungary Water is another *eau de toilette* of comparatively ancient origin, and was prepared mainly from rosemary. The fresh herb was taken and distilled with spirit, variations being sometimes made by the addition of lemon, lavender, or orris. There is very little call for this product to-day, but as it may be of interest the following formula is appended :—

No. 1197.

20	Rosemary oil.
7	Verbena oil.
1·5	Portugal oil.
1	Limette oil.
0·5	Peppermint oil.
100	Triple rose water.
100	Triple orange flower water
800	Alcohol 90 per cent.
1030	

Mature six months.

EAU DE COLOGNE.

Original Type.—Of all the toilet waters sold to the public, none are so popular as eau de Cologne, for it is known universally. There appears to be some doubt as to the actual origin of this perfume, and according to one version it was invented at Milan by Paul de Feminis, who manufactured it at Cologne in 1690. This gentleman is stated to have given the formula to his nephew, Jean Antoine Farina, who commenced to make it at Paris in 1806, and the manufacture of this particular eau de Cologne is supposed to be continued there to-day by a well-known firm. Another version, and probably the correct one, appeared in a well-known English periodical[1] some years ago. According to this account J. M. Farina, who was the veritable inventor of what he called Kölnisches Wasser, or, as it is much more elegantly designated in its French synonym, eau de Cologne, was an Italian by birth, born at Santa Maria Maggiore, in the valley of Vigezza, district Domo d'Ossola, in the year 1685. He had emigrated to Cologne, however, and became a naturalised German, changing his first name to Johann at a somewhat early period. Certainly he was in business "opposite the Julich's Place" in the year 1709, for his commercial books back to that date are still in the possession of the firm. Kölnisches Wasser is among the entries at that period, so that the perfume has been in existence certainly since that date. In 1726 the trade was flourishing, for in that year he sent for his brother John Baptist from Italy, who became his partner. The latter died in 1732, and John Maria, who was unmarried, found himself again alone. Then he sent for the son of John Baptist—who was also his own godson, and was luckily named John Maria—from Italy, and gave him a partnership. In 1766 the original old gentleman died, and left the concern exclusively to this John Maria the second. This one lived till 1792, after which his three sons—John Baptist, John Maria and

[1] "Chemist and Druggist," June 15, 1875.

Charles Antony Hieronymus—reigned in his stead. The middle one of these, who was obviously intended to be the survivor of them all, perversely died first, and so for a moment the famous name was lost to the firm. But the other brothers both named their eldest sons John Maria, and these ultimately succeeded to the proprietorship of the business. The son of John Baptist died in 1833, but the other John Maria is still the head of the house. His son, who is also named John Maria, is actively associated with the senior Mr. Farina in the conduct of the business. The word Farina appears on several makes of eau de Cologne, and this is not surprising, since the name is a common one in Italy. At the present time there are two or three perfumers in Cologne who claim to be the original makers of this favourite toilet water. There is one characteristic about all the old-fashioned eau de Colognes, which is, that they represent a *type*, being, more or less, *citrus* bouquets blended with rosemary or lavender. They possess a refreshing and incomparably sweet aroma, which is typical of all the constituents.

The purity and source of the alcohol employed as a solvent for the oils is a factor which contributes materially to the odour of the finished perfume, and a perfectly neutral and highly rectified potato spirit is undoubtedly the most useful for this purpose. If this should not be available,[1] a treble-distilled molasses or grain alcohol will make a good substitute. Its method of preparation has been alluded to in the monograph on that subject in Volume I. The mere traces of œnanthic ether, which are present in these specially prepared raw materials appear to blend well with the oils and slightly modify their odour. The oils used should be selected from the few rather than the many "possibles," and may include neroli, petitgrain, lemon, orange, and bergamot, with the judicious additions of lavender and either rosemary or thyme.

Distillation also plays a most important rôle in the

[1] It is only obtained easily in Germany.

manufacture of "de luxe" products, but *the oil of neroli should always be added afterwards.* This process has a very subtle influence upon the fragrance of the constituents, and an entirely different and finer product results. The reasons for this peculiar change can only be conjectured, but that some molecular reconstruction of the essential oils takes place on distilling appears to be most probable. When distilling apparatus is not available the oils should be dissolved in the strong alcohol, and the water added little by little. The mixture is then placed aside in tanks when certain terpenes are precipitated. This process may be hastened by freezing, and immediate filtration yields a brilliantly clear liquid which will not cloud under any conditions. Another essential condition in preparing the "de luxe" type is that of maturing the product for at least a year, but with the present duty on alcohol this means the tying up of a considerable sum of money. These difficulties may to some extent be overcome by the addition of ½ per cent of benzoin R., when at the end of one month the bulk will be ready for bottling. The benzoin acts as a fixative, and its odour is scarcely perceptible. Other fixatives are given in the chapter on that subject, but with the exception of benzoin and ambergris they should not be used for the old-fashioned type of eau de Cologne. There are, of course, a number of firms who still use rectified spirit for their toilet waters, but with the availability of better quality industrial alcohol in Britain, a different complexion has been placed upon the manufacture of all perfumery. The Excise authorities will not permit the distillation of this alcohol, so that for all the succeeding formulæ the use of S.V.R. is imperative. If, however, the oils are merely added direct to the spirit then I.M.S. can be used.[1] Since the cost factor is then of minor importance, maturing of the finished product for any period may be resorted to. Products which closely resemble the original may be made as follows :—

[1] The formula must be approved by the Excise authorities.

No. 1198.

Place in a still—

8	Bergamot oil—super.
6	Lemon oil.
5	Sweet orange oil.
1	Lavender oil—French
10	Orris-root—crushed.
500	Alcohol, 90 per cent.
70	Water.
600	

Macerate for 24 hours and then distil slowly.
Collect 500 c.c. in the receiver.
To this add—

2·5	Neroli oil—bigarade.
0·5	Rosemary oil.
500	Alcohol, 90 per cent.
5	Benzoin R.
508	

Mature one month.

No. 1199.

5	Lemon oil.
10	Bergamot oil.
5	Portugal oil.
1	Melissa oil.
50	Rosemary herb.
1000	Alcohol, 90 per cent.
100	Water.
1171	

Macerate for 12 hours in a still and then distil slowly.
Collect 1000 c.c., in which dissolve—

2	Neroli oil.
3·5	Petitgrain oil—French.
0·5	Thyme oil—rectified.
4	Oleo-resin orris.
10	

Mature one month.

No. 1200.

5	Neroli oil.
12	Bergamot oil.
6	Lemon oil.
1	Rosemary oil.
0·5	Origanum oil.
0·5	Lavender oil.
50	Orange flower water triple.
5	Essence ambergris, 3 per cent
950	Alcohol, 90 per cent.
1030	

Dissolve the oils in the alcohol and add the essence.
Macerate 7 days, and shake frequently.
Then add 10 c.c. of triple orange flower water each day for 5 days.
Mature for 12 months.
Filter bright, using talc if necessary.

Modern Prototypes are legion, and a fault possessed by many of them is that they are overloaded with the essential oils already mentioned, and these are frequently supplemented by the addition of cinnamon, cloves, etc. While these alterations in formulæ may be appreciated by some, they, nevertheless, so modify the odour that it is often difficult to identify the perfume as eau de Cologne. Many delightful variations may be made without altering the type, and these are accomplished by the addition of rose, and by substituting—

Mandarin	for	Bitter orange.
Petitgrain citronnier	,,	Sweet orange.
Coriander	,,	Rosemary.
Lime	,,	Lemon.
Clary sage	,,	Lavender.

With regard to the last example, it should be noted that clary sage oil is a magnificent and indispensable fixative, and it is doubtful if any other individual essential oil exerts such an influence on the odour and tenacity of eau de Cologne. It requires to be sparingly employed, and should be added with the neroli *after* distillation. The general procedure should not be varied from that outlined above, but any of the fixatives mentioned in the classified list may be added. The following formulæ will indicate the lines upon which several attractive modern prototypes can be manufactured :—

No. 1201.

5	Lime oil—expressed.
10	Bergamot oil.
7	Portugal oil.
1	Rose oil—virgin.
1	Rosemary oil.
1000	Alcohol, 90 per cent.
100	Water.
1124	

Distil 1000 c.c. in which dissolve—

2	Neroli oil.
0·25	Clary sage oil.
1	Benzyl iso-eugenol.
3	

Mature one month.

No. 1202.

5	Bergamot oil.
6	Lemon oil.
7	Petitgrain-citronnier oil.
2	Rose geranium oil—French.
1	Lavender oil.
1000	Alcohol, 90 per cent.
100	Water.
1121	

Distil 1000 c.c., and add—

5	Petitgrain oil—terpeneless.
1	Neroli oil—bigarade.
2	Colognez, No. 1015.
8	

Mature one month.

No. 1203.

1	Coriander oil.
7	Lime oil—distilled.
7	Mandarin oil.
15	Bergamot oil.
1	Thyme oil—white.
0·5	Canadian snake-root oil.
900	Alcohol, 90 per cent.
200	Water.
1131	

Distil 1000 c.c., to which add—

0·5	Clary sage oil.
1	Vetivert oil—English.
0·5	Santalwood oil.
8	Neroli synthetic, No. 1081
10	

Mature three months.

No. 1204.

0·5	Lime oil—terpeneless.
5	Sweet orange oil.
8·5	Bergamot oil.
1	Verbena oil—French.
800	Alcohol, 90 per cent.
300	Water.
1115	

Distil 1000 c.c., and add—

5	Rose geranium oil.
5	Petitgrain oil, French—terpeneless
0·25	Ethyl cinnamate.
5	Styrax R.
15	

Mature six months, and filter if necessary.

Amber Cologne, No. 1205.

5	Lemon oil.
10	Bergamot oil.
5	Mandarin oil.
5	Bois de rose oil.
1	Rosemary oil.
1·000	Alcohol, 90 per cent.
100	Water.
1126	

Distil 1000 c.c., and add—

10	Ambrone, No. 1007.
0·5	Ethyl cinnamate.
1	Clary sage oil.
3·5	Neroli oil—bigarade.
25	Essence ambergris, 3 per cent.
40	

Mature one month.

Quickly Matured Colognes are best prepared by mixing the oils in bulk and allowing these to stand with frequent shaking for a month. Maturing is accelerated by once daily placing the container in warm water for an hour and then cooling. A matured concentrate thus saves tying up money by maturing for a long time in alcohol. By this method a reasonably good Cologne can be finished off after the oils and alcohol have been mixed a week. A type compound is as follows :—

No. 1206.

300	Bergamot oil.
200	Lemon oil.
150	Mandarin oil.
50	Lavender oil—French.
40	Rosemary oil.
5	Clary sage oil.
70	Neroli oil—bigarade.
100	French petitgrain oil.
10	Rose centifolia, No. 1091.
50	Ethyl acetate.
5	Musk ketone.
20	Benzoin R.
1000	

Dissolve 5 per cent of this compound in 80 per cent industrial alcohol, and after one week freeze and filter bright.

Flower Modifications enjoy a distinct popularity and may be classified as follows :—

1. Those containing the traditional constituents together with the merest floral suggestion. The characteristic odour of eau de Cologne only is at first apparent, but when the olfactory nerves have become accustomed to it, the flower, as it were, takes form, and the effect is both surprising and charming. Mimosa produces one of these most beautiful flower modifications, and will act as a good fixative, especially if the natural absolute is used.

2. Those which do *not* contain any neroli or petitgrain, but have a very pronounced flowery odour. The perfume first recalls the flower, and afterwards eau de Cologne—in many cases there being no suggestion of the latter at all. This type is well represented by "Trèfle Cologne," where the effect is produced by the use of iso-butyl salicylate, or, when this is not available, by amyl salicylate.

Mimosa Cologne, No. 1207.

10	Bergamot.
10	Lemon.
10	Portugal.
10	Petitgrain—terpeneless para.
1	Coriander.
1	Tarragon.
3	Orange absolute.
5	Mimosa absolute.
100	Distilled water.
850	Industrial methylated spirit.
1000	

Mature one month, freeze and filter.

Trèfle Cologne, No. 1208.

20	Bergamot oil.
5	Lemon oil.
1	Rosemary oil.
1	Lavender oil—French.
2	Ylang-ylang oil.

Trèfle Cologne, No. 1208 (*continued*).

1	Clary sage oil.
1	Oakmoss resin.
3	Musk extract, 3 per cent.
1	Rose, No. 1092.
10	Iso-butyl salicylate.
5	Coumarin.
950	Alcohol, 80 per cent.
1000	

Macerate six months, freeze and filter.

Terpeneless Oils now play an important part in the manufacture of eau de Cologne, and their use enables the

Terpeneless Oil.	Quantity Dissolved by 1000 of Ethyl Alcohol at		
	80 per Cent.	70 per Cent.	60 per Cent.
Angelica	850	25	5
Bay	2500	500	150
Bergamot	1200	300	60
Caraway	1900	300	150
Cardamon	1300	450	80
Citronella	1450	20	3
Cloves	1300	800	300
Coriander	1200	300	200
Dill	1500	500	50
Geranium	1300	300	100
Lavender	1800	350	100
Lemon	1300	35	5
Limes	1200	25	3
Mandarin	1300	15	2
Neroli	1250	300	100
Orange	1200	300	2
Peppermint—Mitcham	950	300	80
„ French	1000	300	15
„ American	900	300	18
„ Japanese	1000	300	60
Petitgrain	1200	300	60
Pimento	3000	800	250
Rosemary	1500	350	150
Thyme	1000	450	100
Verbena	1100	300	100

perfumer to employ alcohol of much weaker strength—a very desirable and necessary factor if rectified spirit is employed. Terpeneless and sesquiterpeneless oils should be chosen with care if really fine products are required, as the difference in odour of various makes—of bergamot, for example—is most striking. The approximate quantities to be used when converting any formula can easily be arrived at by a reference to the table of concentrations given in Volume I, and these can be accurately adjusted by practice, until the exact reproduction of the odour with dilute alcohol becomes standardised. In order that the quantities of terpeneless oil for *different strengths* of alcohol may be quickly calculated, a table (after Gattefossé) is given on page 308.

To facilitate the conversion of a formula from the ordinary to the *terpeneless*, let us take a well-known example. The following was the prize-winner in a competition about 1889, and has been immortalised by the "Chemist and Druggist."

The original is as follows :—

No. 1209.

Bergamot oil	2 fluid drachms.
Lemon oil	1 " drachm.
Neroli oil	20 minims.
Origanum oil	6 "
Rosemary oil	20 "
Rectified spirit	1 pint.
Orange flower water triple	1 fluid ounce.

On changing the quantities of all our oils to minims and dividing by the concentrations 3, 16, 3, 3, and 4 our formula will read :—

No. 1210.

Bergamot oil	40 minims.
Lemon oil	4 "
Neroli oil	7 "
Origanum oil	2 "
Rosemary oil	5 "
Alcohol, 60 per cent	1 pint.
Orange flower water triple	1 fluid ounce.

The product will not require filtration and will not deposit on standing. Further, we shall have as good a perfume at two-thirds of the cost!

Cheap Colognes.—The use of industrial methylated spirit has reduced this problem to one of substituting expensive products with cheaper ones and lowering the percentage of essence contained to the limit that the public will accept. The use of iso-propyl alcohol offers no advantages because it is about four times the cost of I.M.S. and, moreover, its odour is not so good. The following substitutions will be found effective :—

Bergamot . . .	Linalyl acetate.
Lemon	Citral from lemon-grass.
Sweet orange and French petitgrain . . .	Petitgrain (Paraguay) or methyl anthranilate or aurantiol or one of the naphthol ethers.
Neroly petales . .	Neroly, No. 1081, or methyl naphthyl ketone.
Rose otto . . .	Rhodinol or geraniol.
Clary sage . . .	Linalyl propionate.
Lavender . . .	Terpinyl acetate.
Coriander . . .	Linalol.
Musk extract . .	Musk ketone.
Ambergris extract . .	Labdanum R.

The greater number of the other commonly used ingredients are not costly and therefore no substitution is necessary.

Two examples are given—No. 1211 being higher priced than No. 1212.

No. 1211.

100	Bergamot.
200	Linalyl acetate.
200	Lemon.
200	Sweet orange.
100	Petitgrain—Paraguay.
70	Neroli, No. 1081.
10	Rhodinol.

40	Lavendin, 20/22 per cent esters.
30	Rosemary—French.
10	Cloves.
10	Musk ketone.
30	Benzoin R.

Dissolve 5 per cent or thereabouts in 80 per cent I.M.S. Stand aside for one week and then filter through kaolin.

No. 1212.

600	Linalyl acetate.
200	Citral.
50	Aurantiol.
30	Ceylon citronella.
50	Terpinyl acetate.
50	Rosemary—Spanish.
20	Musk xylene.
1000	

Use one or two per cent in weak alcohol.

"Frozen" Eau de Cologne is a novel and convenient form in which this useful and refreshing toilet article may be carried in the hand-bag. It is nothing more than a solid and transparent alcoholic soap, prepared by dissolving 5 per cent of sodium stearate in warm alcohol, to which has been added the oils, and carefully running into suitable moulds. Another method preferred by some manufacturers is to dissolve at gentle heat a first-class milling base in alcohol direct. Ten per cent of soap chips or there about make a fairly satisfactory product. This is often slightly tinted with a small quantity of chlorophyll or other green dyestuff, and is then run into plated moulds, which are cooled until solidification is effected. The stick should be wrapped in tinfoil or cellophane to facilitate handling, and packed for sale in air-tight tubes. Exceptional cooling effects are obtained by the addition of suitable quantities of menthol.

LAVENDER WATER.

This is undoubtedly England's most famous perfumed *eau de toilette*, and was originally prepared by macerating the fresh flowers in alcohol and then distilling the mixture. Nowadays the best products are made by maceration only for a prolonged period, the essential constituent being *English* lavender oil. The oil used should be of at least 1 year's maturity, and the bouquet of the finished product is much improved by the addition of about one-half of the quantity of bergamot oil. The best fixatives are civet and musk, but they may be replaced by lavendex if desired (see Toilet Water Fixators). A good formula for this type is as follows :—

No. 1213.

20	Lavender oil—English.
10	Bergamot oil.
5	Lavendex, No. 1014.
5	Tincture of orris.
1000	Alcohol, 90 per cent.
1040	

Mature for *at least six* months and filter if necessary.

Owing to the excessive price of English lavender oil the judicious use of fine quality *French* oil becomes necessary, and in the latter case ageing of the oil may be dispensed with. The employment of about one-third of the amount of this oil is recommended.

No. 1214.

15	Lavender oil—English.
5	Lavender oil—French.
10	Bergamot oil.
1	Clary sage oil.
4	Civet extract, 3 per cent.
5	Orris infusion.
1000	Alcohol, 90 per cent.
1040	

[W.A.P.

FIG. 82.—Collecting English Lavender.

[To face page 312.

Another more elaborate variation of this type is as follows :—

No. 1215.

12	Lavender oil—English.
4	Lavender oil—Mont Blanc.
0·5	Neroli oil.
2	Bergamot oil.
1	Sweet orange oil.
5	Musk extract, 3 per cent.
5	Civet ,, ,,
3	Styrax infusion.
2	Orris tincture.
2	Ambrette oil—10 per cent.
1	Vanillin.
0·5	Benzyl iso-eugenol.
	Alcohol, 90 per cent.
1038	

Quickly Matured Lavenders are prepared by mixing the oils and fixatives for a few weeks and diluting with alcohol a week before use. The modern tendency is to fix with vanilla and oakmoss as well as the animal extracts. Coumarin makes a useful addition as follows :—

No. 1216.

600	Lavender oil—French.
250	Bergamot oil.
20	Neroli, No. 1081.
10	Rose rouge, No. 1092.
20	Orris concrete.
50	Vanilla extract, 10 per cent.
20	Civet extract, 3 per cent.
20	Musk ,, ,,
1	Oakmoss absolute.
1	Patchouli oil.
8	Coumarin.
1000	

Dissolve 7 to 10 per cent in 80 per cent I.M.S. and after one week freeze and filter bright.

Amber Lavenders.—Some people have a distinct preference for this heavier type of lavender water, and the fineness of the bouquet produced by the English oil is much impaired by the presence of so much civet, etc. A really good French oil is therefore all that is necessary to account for the lavender odour in the perfume. Two formulæ follow :—

No. 1217.

25	Lavender oil—French.
5	Bergamot oil.
15	Civet extract, 3 per cent.
5	Ambrone, No. 1007.
1000	Alcohol, 90 per cent.
1050	

No. 1218.

20	Lavender oil—French.
10	Bergamot oil.
2	Lemon oil.
3	Clary sage oil.
1	Musk ambrette.
5	Castoreum extract, 3 per cent.
25	Essence ambergris, ,,
1000	Alcohol, 80 per cent.
1066	

Other Types of lavender water are represented by the following formula, where the introduction of ylang-ylang and jasmin adds a new flower note, and this, together with the slightly camphoraceous odour of the rosemary, produces a very pleasant variation :—

No. 1219.

25	Lavender oil—finest French.
5	Rose, No. 1092.
1	Ylang-ylang oil—Manila.
1	Jasmin absolute.
2	Rosemary oil.
0·25	Nutmeg oil.
1	Oleo-resin orris.
900	Alcohol, 90 per cent.
100	Orange flower water triple.

Add the orange flower water after the other ingredients have macerated one month. Filter bright if necessary.

Terpeneless Products are easily prepared from any formula by calculating the different quantities of oils that will be required (*see* table in Volume I). The following preparation is a good one :—

No. 1220.

10	Lavender oil—French—terpeneless.
4	Bergamot oil—terpeneless.
10	Essence of musk, 3 per cent.
1	Coumarin.
1000	Alcohol, 60 per cent.
1025	

Macerate with frequent shaking for six months.

Cheap lavender perfumes are made by substitution of some of the more expensive ingredients, as follows :—

No. 1221.

600	Lavendin 20/22 per cent esters.
250	Linalyl acetate.
20	Aurantiol.
30	Geranyl acetate.
10	Ionone, 100 per cent.
40	Benzoin R.
20	Coumarin.
30	Musk xylene.

Dissolve 1 or 2 per cent in weak I.M.S.

FLORIDA WATER.

Florida water is a popular perfume in America and a native of that country, just as lavender water is of England. It very closely resembles a mixture of eau de Cologne and lavender water to which has been added cinnamic aldehyde and eugenol. The following formulæ will indicate the lines upon which it may be prepared :—

No. 1222.

15	Lavender oil—French.
5	Portugal oil.
25	Bergamot oil.
10	Petitgrain oil—Paraguay.
1	Eugenol.
1	Cinnamic aldehyde.
5	Rose geranium oil.
2	Oleo-resin orris.
1	Musk ambrette.
200	Orange flower water triple
800	Alcohol, 90 per cent.
1065	

A better product is obtained as follows :—

No. 1223.

5	Neroli oil—bigarade.
5	Lavender oil—English.
30	Bergamot oil—super.
2	Limes oil.
2	Clove oil.
3	Cassia oil.
1	Cinnamon oil.
5	Rose oil—virgin.
2	Amber liquid, No. 1004.
100	Orange flower water triple.
900	Alcohol, 90 per cent.
1055	

Eau de Cananga approximates very closely to eau de Cologne, and most formulæ only show a difference in that the neroli is replaced by cananga or ylang-ylang :—

No. 1224.

5	Cananga oil.
4	Bergamot oil.
1	Lemon oil.
0·2	Benzaldehyde.
2	Musk extract, 3 per cent.
1000	Alcohol, 80 per cent.
1012	

Eau de Portugal also resembles eau de Cologne, *sine neroli*:—

No. 1225.

20	Sweet orange oil.
6	Bergamot oil.
3	Lemon oil.
1	Rose geranium oil.
2	Benzoin R.
1000	Alcohol, 90 per cent.
1032	

CHAPTER IX.

SOAP PERFUMERY.

1. Division of manufacture. Perfuming and milling often a separate business. Milling chips.
2. Soap making. Raw materials, best quality stock. Boiling process. Dry chips. Cold process. Shaving. Transparent. Buying milling chips. Superfatting.
3. Milling process, mixing, milling, plodding, stamping. Coloured soaps. Pigments and dyestuffs used. Cracking.
4. Perfuming, notes on main constituents. Flower oils. Matching with an example of violet. Perfume components. Formulæ for principal soap perfumes.
5. Antiseptic and medicated soaps. Comparative properties of volatile oils. Antiseptic perfume.
6. Perfumed wrappers and boxes.

THE manufacture of toilet soap may be divided broadly into two stages :—

1. The production of the soap base by saponification of fats, oils, etc.

2. The perfuming, milling, plodding, and stamping of this base yielding the finished tablets of toilet soap.

The object of this chapter will be to treat very briefly the first stage and to go into details concerning the second stage. The perfuming of toilet soap is an art acquired by long practice, keen observation of the relationship existing between each aromatic substance and the soap, and attention to small details in the course of milling, plodding, etc. While some cheap soaps are perfumed in the course of the manufacture of the base, all the finer products exhibited on the shop counters are perfumed afterwards, and to-day constitutes, in many cases, a separate business.

There are several qualities of milling chips, some firms manufacturing as many as five. These vary in price according to the raw materials used, and differ widely in colour from an almost pure white to a greyish-yellowish-brown. Practically all these bases are made by boiling. The cold process soaps are seldom an unqualified success since they are rarely neutral. Small makers sometimes manufacture them owing to their easier production.

Raw Materials.—In the manufacture of the best quality soap it is necessary to employ the purest, whitest, and least odorous fats and oils. Those of importance are tallow, cochin coco-nut oil, castor oil, lard, and palm kernel oil. Caustic soda is the alkali almost invariably employed for saponification. This makes a hard and stable soap. Potash produces a soft article. The price and quality of the soap stock varies very much according to the proportion of tallow employed. When this is replaced by hardened oils, a higher proportion of coco-nut oil is used, together with some resin, which makes the finished soap sufficiently plastic for milling. The use of palm kernel oil gives the chips a creamy colour. Darker bases owe their colour to the use of cheaper oils, such as ground nut, etc.

Best Quality Soap Stock, therefore, is made from the following :—

Finest white tallow . .	50-70 per cent.
Cochin coco-nut oil . .	25-30 ,, ,,
Lard	up to 20 ,, ,,
Palm kernel oil . . .	,, 20 ,, ,,
Castor oil	,, 5 ,, ,,
Resin	traces.

The percentage of oils and soft fats are regulated according to the melting-point of the tallow. Castor oil improves the finish. Rancid fats should never be used in good quality soaps. They may be made usable by saponifying the free fatty acids and completely separating the odorous soap from the clear fat. This can be done successfully with poor quality vegetable oils, margarines, and coco-nut oil.

In the larger works the fats are melted by steam blown into the barrels and the liquefied contents pumped to the storage tanks, being run into the pans as required. The caustic soda is generally made by the action of lime on a boiling solution of sodium carbonate. It is evaporated to the necessary specific gravity (degrees Baume) before being run into the pans.

The Boiling Process may be divided into four stages :—

1. *Pasting*, or the preliminary admixture of weak lye and melted fats and oils.
2. *Graining*, or the separation or salting out of the soap.
3. *Boiling on strength* (the most important part of the process), or the further addition of caustic lye from time to time throughout the day to keep the soap "open." This results in the removal of salt and impurities.
4. *Separation* (involving up to a week), or the dissociation of scum, pure soap about 80 per cent, nigre about 20 per cent, and half-spent lyes.

The half-spent lyes and nigre are run off for use again and the pure soap is then made into chips. All modern processes are based on the original Cressonières fundamentals, whereby the liquid soap on leaving the pan is run over cooled rollers and the semi-solid ribbons conveyed by bands through a drying chamber. This takes from 20 to 30 minutes and eliminates about 18 per cent of moisture.

The Dry Chips contain from 75 to 80 per cent of fatty acids and from 8 to 15 per cent of water. The quantity of sodium chloride should be less than 0·25 per cent since a higher percentage will cause the soap to crack and split badly after milling and plodding. The limit of alkalinity is about 0·006 per cent of free soda calculated as sodium oxide.

The Cold Process consists in the saponification of coco-nut oil at low temperatures with high strength alkali. Sometimes small quantities of other fats and oils are added to the coco-nut oil, and for some superfatted soaps the lanoline is added at this stage. The exact quantity of alkali necessary for complete saponification is worked out previously, so that a neutral soap results. In making these soaps it is customary to melt part of the fats, remove the source of heat, and then add the remainder so that when all is liquid the temperature is between 30° and 40° C. The lye at about 40° Baumé is run in gradually while the whole is gently agitated. As saponification takes place the mass becomes uniform and finally translucent. The perfume is now added, and after stirring, the whole is run into frames. Complete saponification is here effected when the temperature rises to about 85° C.

Shaving Soap differs from toilet soap essentially in that saponification is generally effected with potash as well as soda lye, and further that absolute neutrality must be obtained in the finished article to prevent irritation. A creamy and lasting lather is also important. The raw materials must be of the finest and consist principally of tallow and cochin coco-nut oil, together with small quantities of lard oil, castor oil, and lanoline. Soothing and emollient properties are improved by the addition, during milling, of small percentages of soft white paraffin, tragacanth (as mucilage), and glycerine. It is no use boiling the soap with a mixture of soda and potash lyes since double decomposition follows during graining. This difficulty may be overcome by saponification with soda as indicated above, and after separation of the pure soap, and while it is still liquid, crutching in with neutral potassium stearate: the latter being made by the direct saponification of stearic acid. The soap is run from the crutcher into frames to cool. It is subsequently chipped and milled as indicated below.

Transparent Soaps may be prepared in several ways. One of the oldest methods is to dissolve a good quality soap in alcohol by the aid of gentle heat and to then distil off about 80 per cent of the alcohol and run the transparent liquid soap into moulds. This method is expensive but good. Ways of economising have been found by making additions of sugar, castor oil, and glycerine during the process for ordinary good quality millings. In the former method of manufacture a necessary prerequisite for success is a first-class milling base. Such a raw material is more easily and satisfactorily converted from the crystalline to the colloidal state which is really the essence of the process. There is of course no necessity to use duty-paid ethyl alcohol, a good quality industrial methylated spirit, pure methyl alcohol or even iso-propyl alcohol yield good results. The moisture content of the milling chips is important, for the higher this is, the less transparent and brilliant is the finished tablet. Drying should be conducted at a fairly low temperature so that a good colour is preserved. The moisture content should at the completion of this process not exceed 5 per cent. For each hundredweight of soap a 20 gallon jacketed still having stirring apparatus and bottom and side exits is necessary. It is preferable to employ two, one for solution of the soap in the alcohol and the other for recovery of the latter. The recovery kettle should be shallow to allow a large evaporating surface. The temperature is usually about 75° C. The quantity of alcohol necessary for solution varies according to the soap used and to the skill of the operator ; 1 hundredweight of chips will in one case require 5 or 6 gallons of spirit while in another as much as 10 gallons will be necessary. Settling of the dissolved soap demands careful attention and may require up to six hours. The clear supernatant solution is run off into the recovery kettle from the side exit and the residues withdrawn from the bottom for further treatment. The addition of glycerine at this stage in the process is general. The quantity should be kept low owing to its hygroscopic nature ; 1 or 2 per cent is sufficient and will aid transparency, more than this will produce tackiness and a dull finish. The temperature is now maintained at 75° C. and sometimes slightly increased until 75 or 80 per cent of the added alcohol has been recovered. This depends upon how firm the soap will set, and experimental tests are made from time to time to ensure success. The kettle is allowed to cool and then the perfume and any colour in clear solution are added. The liquid soap is now run out into narrow frames or bar moulds and subsequently cut to the size necessary for stamping. Shrinkage will of course occur as the last traces of alcohol evaporate, but this is generally allowed for before cutting. A skilled operator will have so adjusted his process that brilliant transparency and hardness are secured within a few days of manipulation.

A patent was recently taken out by P. Villain for the preparation of transparent soap having a high perfume content by the use of a soluble form or derivative of cellulose. This is alleged to form a film coating on the surface of the soap which prevents deterioration of the perfume.[1]

When Buying Soap Chips it is usually advisable to send the contract samples to a competent analyst for report. The following physical characteristics should also be noticed: colour, dampness, odour, and taste. The first quality chips are generally white, the second slightly creamy, the third darker, and the fourth and fifth brownish. For an average good sample of toilet soap a mixture of equal parts of Nos. 1 and 2 are excellent. Many firms, however, rely entirely on No. 2 for first quality toilets and a mixture in equal parts of 2 and 3 for lower grades. A damp base is more difficult to mill than a normal sample. It is better to buy on the dry side and add the necessary quantity of water during mixing and prior to milling. The first quality chips are practically odourless, the second and third grades have a slight odour reminiscent of traces of para-cresol methyl ether. The lower grades have sometimes quite a strong smell. They can only be used in coloured soaps, but owing to the larger quantity of perfume necessary to cover the odour it generally pays in the long run to buy a better grade base and use less perfume. If the soap tastes salty it should be discarded, since it will crack after plodding and soon become unsaleable. When an analyst's report is obtained the fatty acid content and percentage of free alkali

[1] For complete specification No. 228,282 see "P. and E.O.R." (1925), 81.

or free fat should be noted. Absolute neutrality is very seldom found, but it is better to have traces of free alkali than traces of free fat. The latter soon turn the soap rancid and the quantity of perfume used becomes prohibitive. Free alkali is prone to affect the perfume by the decomposition of esters, etc. This may be counteracted to some extent by the addition of lanoline (about 1 per cent) and the use in the perfume of gum resins such as storax. A dark coloured base can be much improved by the addition of from $\frac{1}{2}$ to 1 per cent of zinc oxide or titanium dioxide. An excess should be avoided, otherwise the appearance will approximate to that of putty.

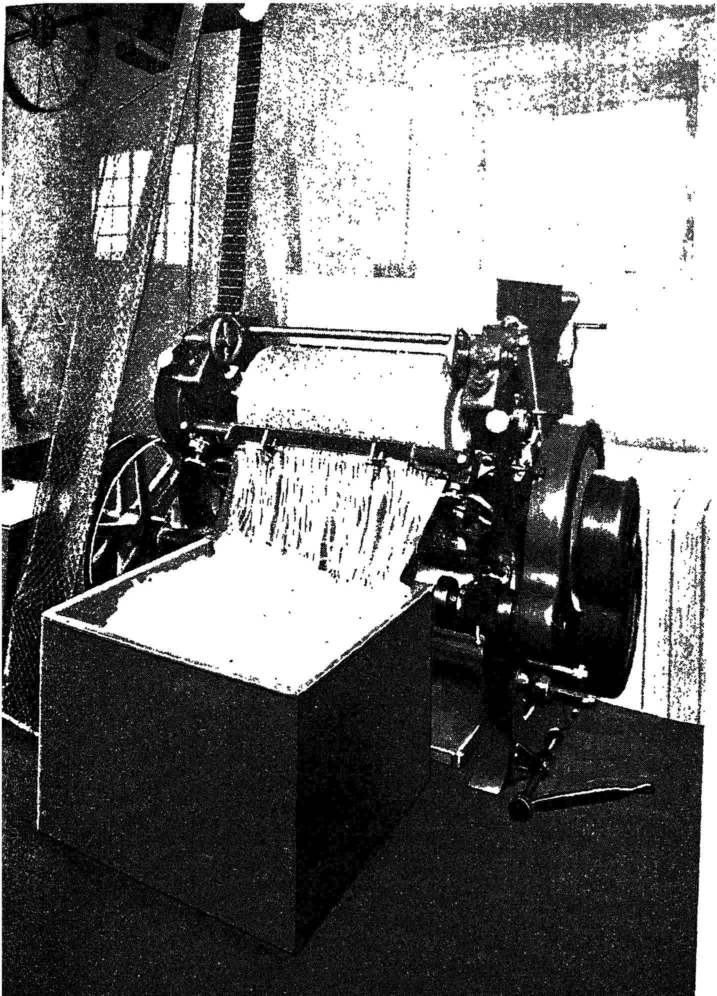
Super-Fatted Toilet Soaps are made by the addition of from 1 to 5 per cent of the following during the milling process :—

Anhydrous lanoline. Soft paraffin jelly.

In both cases the substances are liquefied before being added to the soap chips in the mixer. In the former it is often stirred with a little hot water beforehand. The finished soap tablet has a more shiny appearance and a velvety softness in use. The mere traces of lanoline or soft paraffin left on the skin after washing have a distinctly beneficial effect.

The Milling Process is preceded by mixing. This is effected in a galvanised iron apparatus in which a bent arm revolves. The soap chips, perfume, colour, and superfat are placed together and the arm allowed to revolve until uniform mixation is completed. The apparatus is tipped over and the contents transferred to the hopper of the milling machine. This consists generally of four granite[1] rollers so arranged that as the ribbons come from the top roller they can be dropped when desired on to the two bottom rollers again. The speed at which these four rollers revolve is so regulated, each faster than the other,

[1] In recent years water-cooled steel rollers have been successfully introduced. The output per mill is much greater.



[R. F. White & Co., Ltd.

FIG. 83.—A Four-roller Soap Mill in Operation.

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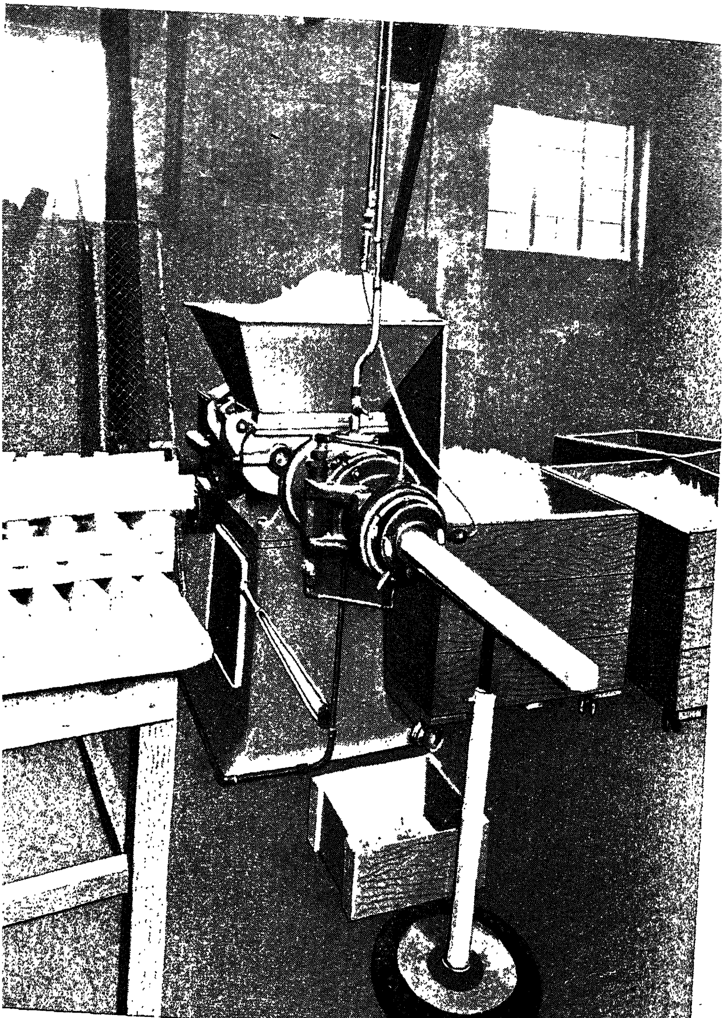

FIG. 84.—A Soap Plodder. [R. F. White & Co., Ltd.

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that the thin sheet of milled soap passes from the bottom to the top one automatically. Four millings are generally enough for all purposes—too much milling results in transparency. After the fourth milling the ribbons are run off the rollers into suitable containers, from which the contents may be easily transferred to the plodder. This is constructed very much on the lines of a huge sausage machine, having a hopper, central screw, and conical-shaped nozzle. This is heated (generally by a gas ring) to give a glossy finish to the soap. The temperature required varies with different bases. It is generally between 40° and 60° C. The screw must be well covered with ribbons to ensure perfect compression. The soap comes from the nozzle in a bar, the size of which is adjusted by the insertion of different plates. The aperture must be kept perfectly smooth (with emery paper) to prevent striation of the soap bar. This is cut to suitable lengths by wire and subsequently to size of tablet in another cutting machine. In large scale production, however, the tablets are automatically cut to size as the bar is forced from the nozzle of the plodder. The tablets are now stamped to the desired shape in machines having moulds made of bronze or brass. They are stood aside on trays for a few hours and then any rough edges trimmed off with knives or scrapers.

Coloured Soaps are not in so much demand to-day as white soaps. These can be improved, as indicated above, by the use of zinc oxide or titanium dioxide. This is also useful for stabilising the colour in coloured soaps. Generally dyestuffs are to be preferred to pigments. Of the latter the following are used and must be lixiviated with water before addition in the mixer :—

Burnt sienna. Ultramarine blue.

Dyestuffs require very careful testing before use. They must be perfectly soluble in hot water, not cause spottiness in the soap, be stable when exposed to light and not used in sufficient quantity to dye any garments. To test the latter it is sufficient that the froth caused by the coloured soap should be white. In general most colours are stable. The important exception is violet, but this difficulty can generally be overcome by blending reds and blues. In making yellow soaps, palm millings (about ½ per cent) are generally to be preferred to a dyestuff.

The colours may therefore be chosen from the following :—

Violet.—Methyl violets, acid violet.

Blue.—Erio fast cyanine, S.E.

Green.—Alizarine or naphthol compounds or chlorophyll.

Yellow.—Palm millings, tartar yellows, metanil compounds, chrysoidine, or diazamine compounds.

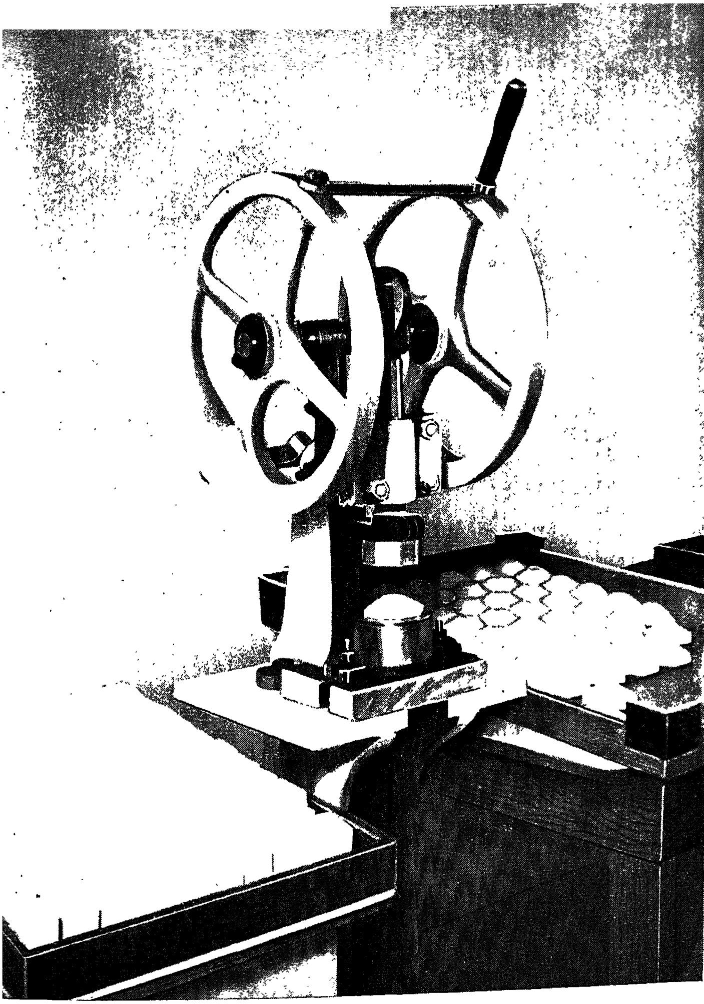
Orange.—Paramine compounds.

Orange II.—Bismarck brown.

Red.—Rhodamine, safranine, acetyl roses.

Brown.—Bismarck brown, burnt sienna, or frequently deep orange dyestuffs.

Cracking in toilet soaps is a troublesome feature which crops up from time to time in the majority of soap plants. It is often attributed to either uneven pressure in the plodder or the presence of too much salt in the soap chips. While it is perfectly true that either of these faults may be responsible for cracked soap, it does not necessarily follow that they are the only cause, because experienced soapmakers are able to control the salt content to a fine point and the man in charge of the milling plant keeps a close eye on the plodder with a view to preventing any insufficient feeding with chips. Readers will have noticed that cracking in soaps is most prevalent from December to March, especially when these months are very cold. During milling the temperature of the soap rises from 10° to 15° C., and it is frequently allowed to stand about afterwards in bins in a cold atmosphere for sufficient time for the temperature to fall again. It is then fed into the plodder where the temperature again rises, and after the stamped tablets have cooled, cracks appear. The author has found that this can



[*R. F. White & Co., Ltd.*

FIG. 85.—A Machine for Stamping Toilet Soap.

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be prevented by keeping the temperature of the chips about 30° C. between mill and plodder. This opinion is confirmed by E. T. Webb.[1]

Perfumes.—The cost of a toilet soap is determined largely by the perfume. A perfect sample should be strong without being harsh and should retain its fragrance right up to the last thin wafer in use. The stability in the presence of alkali of the aromatic substances in any compound is of importance, as also any change in colour which they may effect in the soap after manufacture. Successful soap perfuming therefore requires a knowledge of the durability of each individual raw material when in contact with the soap and any of its constituent impurities. One or 2 per cent of compounded perfume, spread through a large and non-volatile mass has to yield an odour suggestive of the finer alcoholic perfumes in which the solvent plays an important part in determining the delicacy of the finished odour. While alcohol develops the finer ingredients of a perfume, soap on the contrary modifies the odour to such an extent as to often make it unrecognisable in the absence of correct blending. Fixatives play a most important part in soap perfumery and balance the different ingredients of the compound during manufacture and subsequent storage. Stated in another way, the keeping qualities of a perfume in soap largely depend upon successful fixation in which the gum-resins play an important part. Some makers rely upon a very small range of raw materials, and in consequence their products lack variety. Many of the newer synthetics have proved of great value in soap perfumery, but in all cases, before adoption, experiment is necessary. For this purpose a miniature mill and plodder are made by a well-known firm. To save expense, however, many chemists use an ordinary mincing machine, and after passing the perfumed ribbons through two or three times, pound them into a mass in a mortar, and stand aside under ordinary commercial conditions for a month. At

[1] "Soap Trade and Perfumery Review" (1929), 256.

the end of this time the efficiency of any perfume compound can be well judged. To facilitate choice a list of substances with their properties is appended. The stability and keeping qualities are indicated as follows—very good, A ; good, B ; weak, C ; poor, D. These are all that are necessary for the standard lines of soap, but may be added to when the creation of a new bouquet is desired :—

Ajowan oil will replace thyme oil. It is stronger and imparts a pleasing freshness. A.

Almond oil, bitter, useful in acacia and fancy compounds, generally replaced by benzaldehyde, free from chlorine. C.

Ambergris essence, not often used excepting in very high-class soaps, generally replaced by labdanum. B.

Amyl cinnamic aldehyde, useful in jasmin soaps and very persistent. B.

Amyl salicylate, very good in trèfle compounds and quite strong and lasting in use. A.

Aniseed oil, very powerful. Use traces only. B.

Anisic aldehyde, excellent in May blossom and acacia compounds. About 10 per cent sufficient. A.

Atlas cedarwood oil, excellent in acacia, mimosa, santal, and violet. Very strong and lasting. Resinoid also good in fern and chypre. A.

Basil oil, indispensable for mignonette, but requires to be well blended. B.

Bay oil, sometimes used in place of clove oil, valuable in certain types of rose compounds. B.

Benzaldehyde, cheap and useful in almond soaps, traces in violet compounds yield pleasing results. C.

Benzoin, used as a resinoid and also as a tincture made with industrial methylated spirit or iso-propyl alcohol, good fixative but inclined to darken soaps. B.

Benzyl acetate, 5 or 10 per cent will give a refreshing and sweet odour to most soaps, useful in jasmin and orange blossom when blended with petitgrain oil. C.

Benzyl alcohol, weak and faintly balsamic, useful as a fixator. B.

Benzyl benzoate, a good solvent for musk xylene. A.

Benzylidene acetone, useful in the sweet-pea type, blends well with bromstyrole for cheap bouquets. Owing to its irritating effect on the skin, should be used with care. B.

Bergamot oil, very good, often replaced by lemon oil. A.

Beta naphthol ethers, very powerful, but require to be well blended, otherwise coarse. Use in moderation. A.

Bois de Rose oil, indispensable in all rose compounds, much improves Bourbon geranium, and is persistent. A.

Bornyl acetate, the base of all pine perfumes, useful in lavender compounds. A.

Bromstyrole, very powerful and stable, good hyacinth base. A.

Cananga oil, useful in violet and santalwood, not very strong and lacks body. D.

Caraway oil, an indispensable constituent in brown windsor. Rather fleeting. C.

Cassia oil, base for all brown windsors, good blender in bouquets, and should not be overlooked in some rose compounds. Causes darkening. A.

Castoreum tincture, excellent and cheap substitute for musk. A.

Cedarwood oil, strong and persistent, good basis for violets. A.

Cinnamic alcohol, weak but good hyacinth base. A.

Cinnamic aldehyde, occasionally used to replace cassia oil. A.

Cinnamon leaf oil, good substitute for clove oil, darkens in soap. C.

Citral, sometimes used as a substitute for lemon oil. B.

Citronella oils. Both Java and Ceylon very largely employed in all forms of cheap soap compounds, Ceylon frequently preferred and not always on account of its lower cost—very strong. A.

Citronellol, useful in rose compounds. B.

Citronellyl esters, useful as modifiers and blenders. C.

Civet tincture, made with industrial spirit or iso-propyl alcohol, often replaced by synthetic civets based on phenylacetic acid and skatole. A.

Clove oil, much used for imparting a pleasant sweetness to compounds and indispensable in carnation, darkens rapidly. A.

Copaiba resin (*balsam*), good fixative. A.

Coumarin, very good in all compounds, not forgetting lavender. Gives a yellowish tinge in time. A.

Para-Cresol methyl ether, very strong and stable. Use only about 1 per cent. A.

Diphenyl methane and oxide, very strong and stable, substitutes for geranium oil. A.

Ethyl cinnamate, very powerful and balsamic. B.

Eucalyptus oil, traces useful in rose compounds, much used in medicated soaps. A.

Eugenol, good in carnation, but darkens rapidly. B.

Fennel oil, very useful, requires moderation. C.

Geraniol, stable in rose and other compounds, rather weak. B.

Geranium oils, both Algerian and Bourbon indispensable, latter rather coarse, equal parts of each give best results, used in rose and all bouquets. A.

Geranyl acetate, excellent in rose and lavender. C.

Ginger-grass oil, very good, but requires to be well blended. B.

Guaiac-wood oil, one of the finest fixatives, an excellent base for all compounds. A.

Heliotropin, only permissible in coloured soaps, odour good and persistent, indispensable in heliotropes and violets. A.

Hydroxy-citronellal. Use the residues—quite stable and persistent. C.

Ionone, unpurified 100 per cent or residues will yield good results, about 20 per cent sufficient in violets, less in bouquets. B.

Iso-butyl esters, good modifiers and blenders, rather weak excepting the phenylacetate. C.

Iso-eugenol, excellent in carnation but darkens rapidly, colours the soaps containing it. B.

Labdanum, very persistent in small quantities, will replace ambergris, good in lavender. A.

Lavender oil, useless alone, must be strengthened and well blended, oakmoss excellent for the purpose, also rosemary, thyme, and borneol. C.

Lavender oil, spike, very good for cheap lavenders, blend with lemon oil. C.

Lemon-grass oil, basis of all verbenas. Modify with bois de rose or palmarosa—turns the soap yellowish. C.

Lemon oil, inclined to darken slightly. Ten per cent will make a marked difference to many compounds, indispensable in Cologne soaps, but must be well fixed to retard oxidation of terpenes. D.

Linalol. Better use bois de rose oil. A.

Linalyl acetate, good, but better to use bergamot oil. B.

Methyl acetophenone, must be used in small quantities and requires well blending, useful in acacias and mimosas. A.

Methyl anthranilate, very cheap and strong, but inclined to darken, much used as a blender with lemon oil. A.

Methyl benzoate, very strong and stable. A.

Methyl cinnamate, better than ethyl ester, small quantities give an amber note. B.

Methyl heptine carbonate, traces sometimes used in violets, sharp at first but softens after a few days. C.

Methyl salicylate, used in chypre and fern soaps. C.

Mirbane oil. Don't use it. B.

Musk ambrette, about 2 per cent is excellent, more gives a sickly sweetness. Residues are good and cheaper. A.

Musk tincture, made with industrial spirit is indispensable for finest products, useless in rancid bases. A.

Musk xylene, very useful, but make sure it is all dissolved, otherwise the soap will be spotty—turns yellowish in time. A.

Nutmeg oil, used occasionally in lavender compounds. D.

Oakmoss, excellent in lavender, much used in fancy bouquets, very persistent. The green resin is good enough for all purposes. A.

Orange oil, excellent sweetener but must be well fixed, inclined to darken. D.

Orris oil concrete, much used in violets, but often replaced with the oleo-resin or resin extracted from the spent rhizomes. Industrial tinctures of this material useful. B.

Palmarosa oil, good and stable, useful in rose and similar compounds. A.

Patchouli oil, very good and stable, more than 10 per cent becomes unpleasant, much less generally enough, useless in rancid bases. A.

Pepper oil, traces employed in fancy bouquets and carnation compounds. B.

Peppermint oil, traces are useful for developing other odours. A.

Peru balsam, imparts warmth, darkens in time. A.

Petitgrain oil, good in many compounds, but turns yellowish in time, often used for predominating note in glycerine and cucumber and Cologne soaps. B.

Phenylacetic aldehyde, not very valuable in soap, better use bromstyrole. D.

Phenylethyl alcohol, useful in rose compounds. A.

Phenylethyl esters, good blenders, rather weak. C.

Rhodinol, excellent in rose and other compounds usually too expensive. A.

Rosemary oil, good and stable, imparts freshness, useful in many compounds, especially lavender. B.

Safrole, much used in cheap soaps. A.

Sandalwood oil, excellent modifier and fixative in violets and roses, requires to be developed in santal soaps. B.

Sassafras oil, indispensable in chypre and traces in some violets. A.

Spearmint, powerful at first but evanescent. C.

Storax, the best all-round resinous fixative. A.

Terpineol, often the only perfume in cheap soaps, excels rather as a basis on which to build fanciful odours. Use 10 per cent or thereabouts—very stable and strong. A.

Terpinyl esters, fair blenders, but not very stable. C.

Thyme oil, excellent for imparting freshness to all kinds of soap compounds, antiseptic value good. A.

Tolu balsam, good fixative, but inclined to darken. B.

Vanillin, traces useful in fancy bouquets, turns the soap yellowish. B.

Vetivert oil, small quantities are most persistent, good in violets. A.

Flower Oils are only used in the highest priced soaps. They yield excellent results. A cheaper jasmin is made at Grasse by distilling the flowers with cedarwood oil. This product is of considerable value. Mimosa absolute should not be overlooked since it is fairly cheap.

Matching a Perfume of known composition requires experiment and is often necessary when a toilet soap is included in any series of cosmetic products. As will be readily understood it would be impossible, from a pecuniary point of view, to use a first-class compound in soaps. From another point of view it would be equally unsatisfactory, since some of the ingredients might undergo decomposition, cause discoloration, or generally upset the finished odour to such an extent as to make it unrecognisable. A formula therefore requires very careful examination and analysis. Those ingredients which are known to be stable and not too dear are allowed to remain although the quantities may have to be adjusted. The others are eliminated but replaced with raw materials having similar odours. Other substances may have to be added to diffuse the perfume. The most important point is to choose the right combination of fixatives and add just sufficient to regulate the volatility of the perfume. There are, of course, many essential oils having distinctive odours which at the same time act as fixatives as for instance, cedarwood and santal in violets ; patchouli and guaiac-wood in roses. These are always more stable than synthetics but, nevertheless, gum-resins in liberal quantity are imperative constituents. The soap perfumer's stand-by is styrax, but this is by no means the only one of value ; almost all the resinous substances are excellent fixators and many useful variations can be made with them. It should be noted that it is useless to judge the odour of a soap compound by the usual methods. *The* *perfume must be incorporated in the soap by milling and the finished tablet left on one side for a month.* As stated above, the experiments leading up to this stage may be carried out with a mincing machine, etc.

In order to indicate the lines upon which matching may be conducted an example of violet will be examined. A good quality otto for general use in perfumery will be approximately as follows :—

No. 1226.

500	Ionone alpha (1).
80	Orris oil concrete (2).
50	Heliotropin (3).
150	Bergamot oil (4).
30	Ylang-ylang oil—Manila (5).
40	Sandalwood oil (6).
30	Violet leaf absolute (7).
25	Cassie absolute (8).
50	Jasmin „ (9).
1	Aldehyde C_{12} (10).
25	Rose otto—Bulgarian (11).
20	Benzoin R. (12).
1001	

This formula would be adjusted as follows :—

Replace 1 with ionone 100 per cent for soaps and reduce the quantity: Replace 2 with orris oleo-resin and reduce only when costs compel: Retain 3 and 4: Replace 5 with cananga oil and increase: Increase 6: Replace 7 with methyl heptine carbonate and reduce: Omit 8: Replace 9 with benzyl acetate or inexpensive jasmin compound: Omit 10: Replace 11 with Algerian geranium oil and increase: Omit 12: To strengthen and diffuse add cedarwood, clove, and vetivert oils, terpineol and musk ketone or residues.

The formula for a violet soap compound having a similar odour to the above would therefore read :—

No. 1227.

200	Ionone, 100 per cent for soaps.
80	Orris oleo-resin.
50	Heliotropin.
150	Bergamot oil.
50	Cananga oil.
60	Sandalwood oil.
1	Methyl heptine carbonate.
50	Benzyl acetate.
40	Algerian geranium oil.
150	Cedarwood oil.
20	Clove oil.
30	Vetivert oil.
50	Musk residues.
70	Terpineol.
1001	

In making violet soaps some manufacturers add palm millings which emit a violet-like odour. Others add powdered orris-roots, but the use of the oleo-resin dispenses with the necessity.

Soap Compounds.—Two examples of each of the principal toilet soap perfumes will now be given. The first and better quality one being based where possible largely upon essential oils, and the second and cheaper more particularly upon synthetics. They are all workable and are capable of endless modification to suit individual tastes. By applying the principles outlined above it will be quite easy to further cheapen the compound as desired. With a view to assisting the experimenter in the choice of raw materials for odours of specific type, the more important components are enumerated under the heading of their uses—Bases, Blenders, Modifiers, Sweeteners, and Fixers.

ACACIA.

Bases.—Anisic aldehyde, methyl acetophenone, methoxy acetophenone, Atlas cedarwood.

Blenders.—Bois de rose, linalol and esters, methyl anthranilate, phenylethyl alcohol, terpineol.

Modifiers.—Ionones, bromstyrole, phenylacetic aldehyde and acid.

Sweeteners.—Bergamot, geranium, petitgrain, geraniol, benzyl acetate.

Fixers.—Methyl naphthyl ketone, nerolin, methyl cinnamate, musks, benzoin, styrax, cinnamic alcohol, vetivert Bourbon, Peru balsam, coumarin.

Acacia, No. 1228.

100	Bergamot oil.
100	Bois de rose oil.
150	Geranium oil—Bourbon
250	Anisic aldehyde.
50	Methyl acetophenone.
20	Ionone for soaps.
20	Bromstyrole.
100	Atlas cedarwood.
20	β-naphthyl ethyl ether.
30	Benzyl acetate.
10	Vetivert oil.
50	Civet extract, 3 per cent.
50	Rose artificial.
30	Peru balsam.
20	Musk ketone.
1000	

Acacia, No. 1229.

200	Anisic aldehyde.
40	Methyl acetophenone.
240	Terpineol.
100	Java citronella oil.
30	Bromstyrole.
50	Methyl anthranilate.
30	Ionone residues.
10	β-naphthyl ethyl ether.
70	Benzyl acetate.
100	Geraniol.
80	Linalyl acetate
30	Musk residues
20	Styrax.
1000	

ALMOND.

Bases.—Benzaldehyde and bitter almond oil, S.A.P.

Blenders.—Anisic aldehyde, methoxy acetophenone, tarragon, heliotropin.

Modifiers.—Cananga, clove, cassia, fennel.

Sweeteners.—Bergamot, lemon, orange, geranium, bois de rose, santal, aurantiol.

Fixers.—Vanillin, benzoin, musks, benzyl iso-eugenol, patchouli, vetivert, coumarin, styrax, tolu, Peru.

Almond, No. 1230.

500	Bitter almond oil—S.A.P.
200	Bois de rose oil.
50	Cassia oil.
100	Santalwood oil.
100	Peru balsam.
50	Musk xylene.
1000	

Almond, No. 1231.

200	Benzaldehyde—F.F.C.
250	Bois de rose oil.
50	Anisic aldehyde.
300	Citronella oil—Ceylon.
50	Methyl anthranilate.
50	Styrax.
100	Terpineol.
1000	

AMBER.

Bases.—Labdanum, clary sage concrete, castoreum.

Blenders.—Incense, styrax, santal, oakmoss, amyl cinnamate, immortelle.

Modifiers.—Ionones, vetivert, patchouli.

Sweeteners.—Bergamot, geranium, rhodinol.

Fixers. — Musks, coumarin, heliotropin, vanillin, cinnamic alcohol.

Amber, No. 1232.

100	Labdanum resinoid.
50	Clary sage concrete.
200	Santalwood oil.
30	Immortelle absolute.
70	Incense resinoid.
100	Ionone.
50	Vetivert oil—Bourbon.
20	Patchouli oil—Singapore
200	Bergamot oil.
100	Geranium oil.
30	Musk ambrette.
30	Coumarin.
20	Vanillin.
1000	

Amber, No. 1233.

100	Labdanum concrete.
100	Incense resinoid.
200	Santal oil.
100	Vetivert oil—Bourbon.
50	Amyl cinnamate.
150	Methyl cinnamate.
100	Styrax.
100	Geranium oil.
70	Heliotropin.
30	Musk xylene.
1000	

Buttermilk, No. 1234

100	Geranium oil—Algerian.
200	Geranium oil—Bourbon.
100	Clove oil.
100	Terpineol.
200	Cedarwood oil.
100	Santalwood oil—W.A.
80	Petitgrain oil.
40	Patchouli oil.
60	Benzyl acetate.
20	Styrax.
1000	

Buttermilk, No. 1235.

200	Citronella oil—Java.
100	Cedarwood oil.
200	Guaiac-wood oil.
100	Bois de rose oil.
200	Terpineol.
70	Diphenyl methane.
30	Musk xylene.
80	Benzyl acetate.
20	Peru balsam.
1000	

Bouquet, No. 1236.

200	Guaiac-wood oil.
200	Bois de rose oil.
100	Geranium oil—Algerian
10	Vetivert oil.
20	Ionone residues.
100	Cedarwood oil.
100	Terpineol.
90	Clove oil.
100	Lavender oil.
20	Oakmoss resin for soaps.
30	Benzoin R.
30	Musk xylene.
1000	

Usually coloured green.

Bouquet, No. 1237.

200	Terpineol.
200	Phellandrene.
100	Lavender oil—spike.
50	Diphenyl oxide.
100	Cedarwood oil.
200	Citronella oil—Java.
50	Clove oil.
50	Linalyl acetate.
20	Red thyme oil—French.
20	Styrax.
10	Musk xylene.
1000	

BROWN WINDSOR.

Bases.—Cassia oil, artificial cinnamic aldehyde.

Blenders.—Clove, cinnamon leaf, pimento, bay, eugenol, iso-eugenol.

Modifiers.—Lavender, rosemary, thyme, ionone, cedarwood, spike.

Sweeteners.—Caraway, bergamot, petitgrain, geraniol, terpineol, citronella.

Fixers.—Styrax, castoreum, musks.

Brown Windsor, No. 1238.

200	Cassia oil.
50	Caraway oil.
100	Clove oil.
100	Lavender oil.
100	Rosemary oil—French.
50	Thyme oil—French.
100	Petitgrain oil.
100	Bergamot oil.
150	Cedarwood oil.
20	Styrax liquid.
30	Castoreum tincture, 3 per cent.
1000	

Colour orange-brown.

Brown Windsor, No. 1239.

100	Cassia oil.
400	Citronella oil--Ceylon.
100	Clove residues.
200	Terpineol.
30	Red thyme oil.
100	Phellandrene.
20	Caraway oil.
50	Rosemary oil—Spanish.
1000	

Cedarwood, No. 1240.

150	Santalwood oil—E.I.
10	Bromstyrole.
100	Cananga oil.
100	Terpineol.
150	Methyl ionone residues.
250	Cedarwood oil.

150 Geranium oil—Bourbon
30 Vetivert oil—Bourbon.
10 Orris concrete.
50 Heliotropin.

1000

Cedar, No. 1241.

600 Cedarwood oil.
100 Santalwood oil—W.A.
30 Ionone residues.
100 Geraniol.
100 Phenylethyl alcohol.
20 Vetivert oil.
50 Coumarin.

1000

CARNATION.

Bases.—Eugenol, iso-eugenol, clove oil, amyl salicylate, bromstyrole, styrax.

Blenders.—Bay, cinnamon leaf, pimento, phenylethyl alcohol, iso-butyl phenylacetate, black pepper oil, amyloxy-iso-eugenol, heliotropin.

Modifiers.—Cananga, aurantiol, ionone, geranyl acetate, benzyl acetate.

Sweeteners.—Bois de rose, bergamot, geranium, terpineol.

Fixers.—Benzyl salicylate, musks, Peru balsam, acetyl eugenol, benzoin, cinnamic alcohol.

Carnation, No. 1242.

20 Black pepper oil.
30 Benzyl iso-eugenol.
250 Iso-eugenol.
150 Clove oil.
100 Geranium oil.
50 Cananga oil.
50 Bois de rose oil.
150 Terpineol.
100 Amyl salicylate.
40 Bromstyrole.
50 Peru balsam.
10 Musk ambrette.

1000

Sometimes coloured brown.

Carnation, No. 1243.

100	Iso-eugenol.
300	Clove oil.
150	Amyl salicylate.
60	Geraniol.
40	Phenylethyl alcohol.
50	Ionone residues.
30	Musk residues.
20	Heliotropin.
20	Bromstyrole.
200	Terpineol.
30	Styrax.
1000	

CHYPRE.

Base.—Oakmoss.

Blenders.—Patchouli, sandalwood, vetivert.

Modifiers.—Cananga, clary sage concrete, ambreine, benzyl acetate, amyl salicylate, cypress, ionones, terpinyl acetate, heliotropin.

Sweeteners.—Bergamot, pimento, styrax oil, verbena, lavender, lemon, cassia, sassafras, bois de rose, geranium.

Fixers.—Musks, coumarin, labdanum, incense, castoreum, Peru balsam, vanillin, benzoin, ethyl cinnamate.

Chypre, No. 1244.

40	Oakmoss absolute—colourless.
20	Sassafras oil.
10	Labdanum clair.
150	Bergamot oil.
80	Patchouli oil.
200	Sandalwood oil—E.I.
50	Methyl cinnamate.
30	Benzoin R.
20	Peru balsam.
250	Rhodinol.
80	Methyl ionone residues.
20	Musk ambrette.
50	Jasmin—colourless, No. 1055.
1000	

Chypre, No. 1245.

100	Oakmoss for soaps.
30	Cassia.
10	Labdanum clair.
100	Bois de rose oil.
100	Geranium oil—Algerian.
50	Coumarin.
50	Musk residues.
20	Styrax.
50	Ionone residues.
30	Benzyl acetate.
400	Terpineol.
50	Patchouli oil.
10	Methyl anthranilate.
1000	

Curd, No. 1246.

300	Citronella oil—Ceylon.
50	Cassia oil.
150	Lemon oil.
50	Caraway oil.
250	Geranium oil—Bourbon
100	Bergamot oil.
30	Peppermint oil.
70	Terpineol.

Curd, No. 1247.

200	Safrole.
300	Geraniol.
500	Terpineol.
1000	

COLOGNE.

Bases.—Petitgrain, methyl anthranilate.

Blenders.—Bergamot, lemon, orange, citral.

Modifiers.—Lavender, rosemary, spike, clove, terpinyl acetate, coriander.

Sweeteners.—Geranyl acetate, thyme, terpineol, geranium, hydroxy-citronellal, benzyl acetate.

Fixers.—Musks, methyl naphthyl ketone, clary sage, methyl cinnamate, nerolin, benzoin, Canada balsam.

Cologne, No. 1248.

200	Petitgrain oil—French.
300	Lemon oil.
100	Lavender oil.
50	Rosemary oil—French.
30	Thyme oil—French.
150	Bergamot oil.
10	Clary sage concrete.
10	Musk ambrette.
100	Terpineol.
50	Sweet orange oil.
1000	

Cologne, No. 1249.

100	Bois de rose oil.
200	Methyl anthranilate.
200	Citronella oil—Ceylon
50	β-naphthyl ethyl ether
100	Linalyl acetate.
250	Terpineol.
50	Ajowan oil.
50	Rosemary oil.
1000	

CYCLAMEN.

Bases.—Hydroxy-citronellal, terpineol, ionones.

Blenders.—Linalol, phenylethyl alcohol, orris.

Modifiers.—Cinnamyl acetate, amyl salicylate, benzyl acetate, amyl cinnamic aldehyde, methyl heptine carbonate, phenylacetic aldehyde, heliotropin.

Sweeteners.—Bergamot, citral, iso-propyl alphamethyl hydrocinnamic aldehyde, geraniol, cananga.

Fixers.—Cinnamic alcohol, musks, styrax, olibanum.

Cyclamen, No. 1250.

200	Hydroxy-citronellal.
100	Ionone, 100 per cent.
100	Linalol.
70	Phenylethyl alcohol.
30	Cinnamyl acetate.
50	Benzyl acetate.

10	Phenylacetic aldehyde.
20	Amyl salicylate.
20	Citral.
100	Bergamot.
150	Geraniol.
10	Iso-propyl alphamethyl hydrocinnamic aldehyde.
70	Cinnamic alcohol.
40	Styrax.
30	Musk ketone.
1000	

Cyclamen, No. 1251.

300	Hydroxy-citronellal.
250	Bois de rose.
100	Phenylethyl acetate.
20	Amyl cinnamic aldehyde.
100	Citronella—Ceylon.
30	Heliotropin.
150	Terpineol.
50	Musk xylene.
1000	

FOUGERE.

Bases.—Coumarin, oakmoss.

Blenders.—Lavender, cananga, cedarwood, ionones.

Modifiers.—Patchouli, vetivert, amyl salicylate, methyl benzoate, methyl acetophenone, bornyl acetate, acetanisol, heliotropin.

Sweeteners.—Bergamot, lemon, geranium, citronellol, sassafras, anisaldehyde, thyme, ajowan.

Fixers.—Musks, santal, tolu and Peru balsams, vanillin, dimethyl hydroquinone, castoreum.

Fougere, No. 1252.

200	Coumarin.
50	Oakmoss resinoid.
100	Lavender oil.
50	Cananga oil.
30	Patchouli oil.
20	Vetivert oil.
40	Acetanisol.

Fougere, No. 1252 (*continued*).

150	Bergamot oil.
150	Geranium oil.
110	Santal oil.
30	Musk ketone.
70	Tolu balsam.
1000	

Fougere, No. 1253.

200	Coumarin.
50	Oakmoss resin.
150	Lavender oil.
150	Cedarwood oil.
20	Patchouli oil.
10	Vetivert oil.
30	Amyl salicylate.
40	Bornyl acetate.
200	Lemon oil.
20	Anisaldehyde.
80	Heliotropin.
50	Musk xylene.
1000	

Glycerine and Cucumber, No. 1254.

300	Bergamot oil.
100	Linalol.
250	Petitgrain oil—French.
100	Palmarosa oil.
100	Clove oil.
30	Jasmin colourless, No. 1055.
20	Rose synthetic.
30	Benzoin R..
30	Peru balsam.
10	Musk ambrette.
20	Coumarin.
10	Patchouli oil.
1000	

Colour green.

Glycerine and Cucumber, No. 1255.

220	Ceylon citronella oil.
200	Terpineol.
50	Lemon-grass oil.
250	Bois de rose oil.
100	Benzyl acetate.
100	Clove oil.
30	Styrax.
50	Musk xylene.
1000	

Colour green.

HELIOTROPE.

Bases.—Heliotropin, vanillin.

Blenders.—Cinnamic alcohol, phenylethyl alcohol, ionones, anisyl acetate, benzaldehyde, anisaldehyde.

Modifiers.—Bromstyrole, cananga, benzyl acetate, and cinnamate.

Sweeteners.—Bergamot, phenylacetaldehyde, geranium, clove, geraniol.

Fixers.—Peru balsam, styrax.

Heliotrope, No. 1256.

300	Heliotropin.
30	Vanillin.
50	Coumarin.
20	Musk ambrette.
200	Geranium oil—Algerian.
100	Bois de rose oil.
20	Almond oil—bitter S.A.P.
30	Balsam of Peru.
50	Benzoin R.
70	Anisic aldehyde.
30	Jasmin colourless, No. 1055.
100	Clove oil.
1000	

Colour violet.

Heliotrope, No. 1257.

320	Heliotropin.
30	Vanillin.
30	Coumarin.
20	Styrax.
[illegible]	Benzaldehyde.

Heliotrope, No. 1257 (*continued*).

30	Anisic aldehyde.
40	Benzyl acetate.
50	Musk residues.
10	Nerolin.
100	Linalyl acetate.
50	Clove oil.
100	Geraniol.
200	Terpineol.
1000	

Colour violet.

Herb, No. 1258.

100	Thyme oil—Spanish.
100	Rosemary oil—French.
200	Lavender oil—spike.
50	Fennel oil.
50	Spearmint oil.
300	Geranium oil—Bourbon.
50	Cassia oil.
100	Clove oil.
50	Camomile oil.
1000	

Colour brown.

Herb, No. 1259.

500	Herb compound, No. 1258
100	Citronella oil—Java.
300	Terpineol.
100	Phellandrene.
1000	

Colour brown.

Honey, No. 1260.

200	Bergamot oil.
200	Bois de rose oil.
100	Geranium oil—Algerian.
100	Miel compound, Vol. I.
50	Rose, No. 1092.
50	Jasmin, No. 1055.
40	Civet extract, 3 per cent.
30	Peru balsam.
30	Musk ketone.
100	Phenylethyl alcohol.
100	Terpineol.
1000	

Honey, No. 1261.

450	Citronella oil—Ceylon.
200	Lemon oil.
100	Cinnamon leaf oil.
50	Bay oil.
20	Iso-butyl phenylacetate.
100	Phenylethyl alcohol.
30	Phenylacetic acid.
50	Musk residues.
1000	

HYACINTH.

Bases.—Phenylacetaldehyde, bromstyrole.

Blenders.—Phenyl propyl alcohol, cinnamic alcohol, phenylethyl acetate, ionones.

Modifiers.—Cananga, cinnamyl acetate, cinnamic aldehyde, hydrocinnamic aldehyde, benzyl acetate, amyl cinnamic aldehyde, methyl acetophenone.

Sweeteners.—Bois de rose, terpineol, clove, geranium, cedrat, basil, iso-eugenol, bergamot.

Fixers.—Galbanum, benzyl phenylacetate, para-cresyl phenylacetate, musk ambrette, methyl cinnamate, styrax.

Hyacinth, No. 1262.

200	Cinnamic alcohol.
60	Bromstyrole.
100	Bergamot oil.
30	Phenyl propyl alcohol.
50	Neroli, No. 1081.
20	Methyl cinnamate.
100	Terpineol.
80	Cananga oil.
200	Guaiac-wood oil.
50	Styrax.
100	Geranium oil—Bourbon.
10	Musk ambrette.
1000	

Hyacinth, No. 1263.

100	Cinnamic alcohol.
30	Bromstyrole.
20	Phenylacetic aldehyde.
200	Bois de rose oil.

Hyacinth, No. 1263 (*continued*).

50	Styrax.
50	Musk residues.
300	Terpineol.
200	Citronella oil—Ceylon.
50	Ionone residues.
1000	

JASMIN.

Bases.—Amyl cinnamic aldehyde, benzyl acetate.

Blenders.—Ionones, methyl anthranilate, benzyl chloracetate, decahydro betanaphthyl acetate, phenylethyl alcohol.

Modifiers.—Cyclohexanyl butyrate, ylang, hydroxy-citronellal, linalyl acetate, cinnamyl acetate, benzyl butyrate and propionate, phenylacetic acid.

Sweeteners.—Orange, bergamot, bois de rose, petitgrain, geraniol, undecalactone.

Fixers.—Musks, para-cresyl phenylacetate, benzyl acetone, benzyl salicylate, aceto naphthone, styrax, civet.

Jasmin, No. 1264.

250	Bois de rose oil.
200	Benzyl acetate.
50	Cinnamic alcohol.
100	Sweet orange oil.
100	Phenylethyl alcohol.
50	Ylang-ylang oil—Bourbon.
19	Amyl cinnamic aldehyde.
1	Undecalactone.
70	Methyl anthranilate.
60	Hydroxyl-citronellal.
50	Civet extract, 3 per cent.
50	Jasmin over cedarwood.
1000	

Colour yellow.

Jasmin, No. 1265.

330	Benzyl acetate.
120	Linalol.
80	Methyl anthranilate.
100	Orange oil—sweet.
100	Cananga oil.
100	Hydroxy-citronellal residues

20	Styrax.
50	Cedarwood oil.
100	Terpineol.
1000	

Colour yellow.

LAVENDER.

Bases.—Lavender, spike, lavandin.

Blenders.—Coumarin, patchouli, sandal.

Modifiers.—Bois de rose, petitgrain, rosemary, terpinyl acetate, borneol, terpineol, methyl anthranilate, rhodinyl acetate, eugenol.

Sweeteners.—Bergamot, thyme, geraniol, linalyl acetate, eppermint, clove, geranyl acetate.

Fixers.—Oakmoss, musks, styrax, orris resin, benzyl acetone, benzylidene acetone, Peru balsam, labdanum, angelica, clary sage concrete.

Lavender, No. 1266.

300	Lavender oil—M.B.
150	Lavender oil—spike.
40	Patchouli oil.
60	Santalwood oil—E.I.
100	Bergamot oil.
10	Oakmoss absolute.
20	Thyme oil.
10	Labdanum clair.
5	Orris concrete.
5	Musk ambrette.
60	Coumarin.
10	Peppermint oil—American.
50	Civet extract, 3 per cent.
50	Vanilla extract, 10 per cent.
30	Petitgrain oil.
100	Rosemary oil—French.
1000	

Lavender, No. 1267.

100	Lavandin oil.
400	Lavender oil—spike.
100	Rosemary oil—French.
50	Thyme oil—French.
[illegible]	Oakmoss for soaps.

Lavender, No. 1267 (*continued*).

50	Borneol.
100	Terpinyl acetate.
100	Bois de rose oil.
20	Styrax.
50	Musk residues.
1000	

Colour violet.

LILAC.

Bases.—Terpineol, anisic aldehyde.

Blenders.—Phenylacetic aldehyde, bromstyrole, cananga, hydroxy-citronellal, para-cresol methyl ether.

Modifiers.—Phenylacetaldehyde dimethylacetal, cinnamic alcohol, phenylethyl alcohol, iso-eugenol, benzyl acetate, amyl cinnamic aldehyde, benzaldehyde, amyl salicylate, ionones, heliotropin.

Sweeteners.—Petitgrain, geraniol, linalol, cinnamyl acetate, anisic alcohol, methyl acetophenone, undecalactone.

Fixers.—Indole, musk ketone, coumarin, styrax, benzoin, vanillin, methoxy acetophenone, methyl naphthyl ketone, phenylacetic acid.

Lilac, No. 1268.

30	Phenylacetic aldehyde.
20	Bromstyrole.
150	Terpineol.
50	Bois de rose oil.
20	Ylang-ylang oil—Bourbon.
100	Petitgrain oil—French.
10	Iso-eugenol.
100	Hydroxy-citronellal.
1	Gamma undecalactone.
50	Anisic aldehyde.
40	Styrax.
25	Musk ketone.
100	Cinnamic alcohol.
50	Benzyl acetate.
150	Phenylethyl alcohol.
100	Heliotropin.
4	Indole.
1000	

Lilac, No. 1269.

300	Terpineol.
200	Bois de rose oil.
40	Cananga oil.
200	Phenylethyl alcohol.
2	Benzaldehyde.
70	Benzyl alcohol.
30	Peru balsam.
50	Musk xylene.
50	Heliotropin.
20	Bromstyrole.
35	Anisic aldehyde.
3	Indole.
1000	

Colour violet.

LILY.

Bases.—Linalol, bois de rose, hydroxy-citronellal.

Blenders.—Cananga, dimethyl benzyl carbinol, phenyl propyl aldehyde, ethyl phenylacetate, citronellal, citronella-Ceylon, phenylethyl alcohol.

Modifiers.—Ionones, almonds, cinnamic alcohol and esters, anisaldehyde, cardamon, phenylglycol acetate, bromstyrole, heliotropin.

Sweeteners.—Terpineol, bergamot, orange, geranium, methyl anthranilate, undecalactone, benzyl acetate.

Fixers.—Musks, para-cresyl phenylacetate, methyl naphthyl ketone, civette, benzoin.

Lily, No. 1270.

240	Hydroxy-citronellal.
300	Bois de rose oil.
100	Terpineol.
100	Ylang-ylang oil—Bourbon.
50	Geranium oil—Algerian.
30	Sweet orange oil.
30	Jasmin colourless.
1	Cardamon oil.
4	Methyl naphthyl ketone.
30	Musk ketone.
50	Civet extract, 3 per cent.
50	Benzoin R.
15	Heliotropin.

Lily, No. 1271.

200	Terpineol.
200	Hydroxy-citronellal residues.
250	Bois de rose oil.
100	Cananga oil.
100	Geraniol.
60	Ionone residues.
20	Heliotropin.
10	Methyl anthranilate.
50	Musk residues.
10	Bromstyrole.
1000	

May Blossom, No. 1272.

200	Anisic aldehyde.
50	Methyl acetophenone.
100	Bergamot oil.
300	Bois de rose oil.
50	Petitgrain oil.
30	Phenylacetic aldehyde.
30	Rose, No. 1092.
20	Jasmin colourless, No. 1055
20	Styrax.
30	Benzoin R.
50	Civet extract, 3 per cent.
30	Musk extract, ,,
20	Coumarin.
70	Heliotropin.
1000	

May Blossom, No. 1273.

150	Anisic aldehyde.
50	Iso-butyl phenylacetate.
200	Bois de rose oil.
300	Ceylon citronella oil.
20	Styrax.
40	Heliotropin.
40	Musk xylene.
20	Bromstyrole.
180	Terpineol.
1000	

Musk, No. 1274.

20	Musk ambrette.
30	Musk ketone.
40	Vetivert oil.
100	Santalwood oil—E.I.
110	Methyl ionone.
70	Ambrone, No. 1007.
100	Bergamot oil.
200	Geranium oil—Bourbon.
100	Musk extract, 3 per cent.
50	Civet extract, ,,
50	Castoreum extract, 3 per cent.
100	Terpineol.
30	Cassia oil.
1000	

Musk, No. 1275.

100	Geranium oil—Algerian.
100	Clove oil.
30	Cassia oil.
20	Labdanum.
50	Castoreum tincture, 3 per cent
50	Sandalwood oil—W.A.
150	Cedarwood oil.
30	Ionone residues.
20	Vetivert oil.
150	Musk xylene.
150	Benzyl benzoate.
150	Terpineol.
1000	

NARCISSUS.

Bases.—Para-cresyl esters—acetate, phenylacetate, isobutyrate and para-cresol methyl ether.

Blenders.—Terpineol, linalol, acetanisol, cananga, anisaldehyde.

Modifiers. — Phenylethyl acetate, iso-eugenol, phenylethyl alcohol, methyl anthranilate, petitgrain, ionones, amyl cinnamic aldehyde, heliotropin.

Sweeteners.—Bergamot, benzyl acetate, bromstyrole, citral, phenylethyl cinnamate, geraniol.

Fixers.—Musk ambrette, santal, benzoin, cinnamic alcohol, methyl naphthyl ketone, labdanum.

Narcissus, No. 1276.

250	Terpineol.
150	Geraniol.
80	*p*-cresyl phenylacetate.
50	Phenylacetaldehyde.
100	Bois de rose oil.
40	Cananga oil.
150	Petitgrain oil.
50	Iso-eugenol.
50	Amyl cinnamic aldehyde.
40	Aubepine.
30	Heliotropin.
10	Musk ambrette.
1000	

Narcissus, No. 1277.

500	Terpineol.
240	Ceylon citronella oil.
30	Para-cresyl iso-butyrate.
30	Bromstyrole.
40	Cananga oil.
50	Clove oil.
50	Benzyl acetate.
40	Heliotropin.
20	Citral.
1000	

OPOPONAX.

Bases.—Opoponax resinoid, labdanum.

Blenders.—Coumarin, vanillin, heliotropin, musks.

Modifiers.—Benzyl acetone, phenylethyl alcohol, ionones, jasmin compounds, rose compounds.

Sweeteners.—Bergamot, citral, salicyl aldehyde, geranium, citronellol.

Fixers.—Myrrh, incense, santal, benzoin, castoreum, Peru balsam, tolu balsam.

Opoponax, No. 1278.

400	Bergamot oil.
220	Geranium oil.
80	Opoponax resinoid.
20	Labdanum resinoid.

100	Coumarin.
30	Vanillin.
70	Heliotropin.
50	Musk xylene.
20	Incense resinoid.
10	Castoreum resinoid.
1000	

Opoponax, No. 127

500	Ceylon citronella oil.
50	Citral.
50	Tolu balsam.
70	Benzoyl acetone.
100	Vanillin.
100	Coumarin.
30	Benzyl acetate.
100	Benzoin.
1000	

Palm and Olive Oils, No. 1280.

100	Bromstyrole.
200	Bois de rose oil.
30	Cassia oil.
70	Clove oil.
100	Lavender oil.
50	Patchouli oil.
150	Cedarwood oil.
100	Petitgrain oil.
150	Geranium oil—Bourbon
50	Musk xylene.
1000	

Colour green.

Palm and Olive Oils, No. 1281.

500	Palm compound, No. 1280.
200	Terpineol.
300	Lavender oil—spike.

Pine Bouquet, No. 1282.

200	Bornyl acetate.
100	Geranium oil—Algerian.
40	Cassia oil.
50	Clove oil.
50	Petitgrain oil.
250	Lavender oil—M.B.
200	Bergamot oil.
50	Terebene.
20	Musk ambrette.
30	Coumarin.
10	Patchouli oil.
1000	

Pine Bouquet, No. 1283

50	Borneol.
100	Bornyl acetate.
100	Cedarwood oil.
200	Lavender oil—spike.
50	Methyl anthranilate.
100	Bois de rose oil.
200	Terpineol.
100	Citronella oil—Java.
50	Terebene.
30	Musk residues.
20	Coumarin.
1000	

ROSE.

Bases.—Geranium oils, phenylethyl alcohol, diphenyl oxide, and methane.

Blenders.—Geraniols, bois de rose, palmarosa, ginger-grass, citronella, cinnamic alcohol.

Modifiers.—Esters of all rose alcohols, ionones, terpineol, cassia, patchouli.

Sweeteners.—Bergamot, clove, lemon, benzyl acetate, petitgrain.

Fixers.—Musks, styrax, guaiac-wood, methyl cinnamate, santal, phenylacetic acid, labdanum, benzoin.

Rose, No. 1284.

200	Geranium oil—Algerian.
150	Geranium oil—Bourbon.
100	Bois de rose oil.
20	Patchouli oil.
100	Clove oil.
30	Geranyl acetate.
60	Santalwood oil—E.I.
100	Phenylethyl alcohol.
70	Palmarosa oil.
60	Peru balsam.
50	Rose, No. 1092.
30	Ionone alpha.
30	Civet extract, 3 per cent.
1000	

Colour yellowish-pink.

Rose, No. 1285.

200	Palmarosa oil.
100	Ginger-grass oil.
150	Geraniol.
100	Bois de rose oil.
50	Clove oil.
100	Phenylethyl alcohol.
70	Diphenyl methane.
30	Musk xylene.
200	Terpineol.
1000	

SANTAL.

Bases.—Santalwood oils, copaiba resin, cedarwood oil, atlas cedar.

Blenders.—Patchouli, vetivert, mace, nutmeg.

Modifiers.—Clove, cassia, lavender, bois de rose, oak-moss.

Sweeteners.—Geranium, bergamot, terpineol, cananga.

Fixers.—Musks, coumarin, heliotropin, Peru balsam, civet, dimethyl hydroquinone.

Santal, No. 1286.

300	Sandalwood oil—E.I.
300	Atlas cedar oil.
50	Clove oil.
20	Cassia oil.
30	Patchouli oil.
150	Geranium oil—Bourbon.
50	Cananga oil.
50	Bergamot oil.
20	Musk ambrette.
20	Coumarin.
10	Oakmoss absolute.
1000	

Colour yellowish-brown.

Santal, No. 1287.

200	Sandalwood oil—W.A.
300	Cedarwood oil.
50	Bois de rose oil.
100	Lavender oil—spike.
50	Geraniol.
100	Musk residues.
200	Terpineol.
1000	

Shaving Stick, No. 1288.

300	Geranium oil—Algerian.
170	Bois de rose oil.
20	Almond oil—bitter S.A.P.
20	Vetivert oil.
100	Terpineol.
70	Rose, No. 1092.
100	Jasmin colourless, No. 1055
100	Sandalwood oil—E.I.
50	Benzoin R.
50	Civet extract, 3 per cent.
20	Styrax.
1000	

Shaving Stick, No. 1289.

250	Citronella oil—Ceylon.
300	Lavender oil—spike.
100	Sandalwood oil—W.A.

60	Coumarin.
40	Amyl salicylate.
50	Musk residues.
200	Terpineol.
1000	

SWEET PEA.

Bases.—Phenylethyl acetate, benzoyl acetone, benzylidene acetone.

Blenders. — Bromstyrole, phenylacetaldehyde, phenylethyl alcohol and phenylacetate.

Modifiers. — Anisic aldehyde, methyl acetophenone, cananga, methyl anthranilate, rose alcohols, phenylacetaldehyde dimethylacetal, ionones, heliotropin.

Sweeteners. — Geranium, bergamot, terpineol, clove, benzyl acetate, petitgrain.

Fixers.—Cinnamic alcohol, styrax, musks, nerolin.

Sweet Pea, No. 1290.

150	Phenylacetic aldehyde.
20	Bromstyrole.
40	Benzylidene acetone.
100	Terpineol.
400	Petitgrain oil para.
50	Clove oil.
140	Styrax.
70	Heliotropin.
30	Musk ambrette.
1000	

Sweet Pea, No. 1291.

30	Bromstyrole.
20	Benzylidene acetone.
100	Geranium oil—Algerian
50	Clove oil.
10	Styrax.
30	Musk residues.
50	Heliotropin.
10	Nerolin.
500	Terpineol.
200	Citronella oil—Ceylon.
1000	

Transparent, No. 1292.

450	Geranium oil—Bourbon
40	Patchouli oil.
10	Vetivert oil.
100	Clove oil.
30	Cassia oil.
20	Caraway oil.
100	Lavender oil—M.B.
10	Orris concrete
40	Methyl ionone.
20	Coumarin.
30	Musk ketone.
50	Civet extract, 3 per cent.
100	Terpineol.
1000	

Transparent, No. 1293.

100	Citronella oil—Java.
50	Cassia oil.
50	Clove oil.
100	Thyme oil.
50	Sassafras oil.
250	Lavender oil—spike
200	Geraniol.
180	Cedarwood oil.
20	Musk xylene.
1000	

Trèfle, No. 1294.

100	Geranium oil—Bourbon.
10	Oakmoss resin.
100	Bois de rose oil.
50	Peru balsam.
400	Amyl salicylate.
50	Rose, No. 1092.
40	Jasmin colourless, No. 1055
100	Bergamot oil.
50	Phenylethyl alcohol.
100	Cananga oil.
1000	

Trèfle, No. 1295.

400	Amyl salicylate.
100	Geraniol.
50	Phenylethyl alcohol.
20	Bromstyrole.
250	Terpineol.
50	Benzylacetate.
30	Musk residues.
100	Bois de rose oil.
1000	

VERBENA.

Bases.—Lemon-grass, citral, verbena, citronella.

Blenders.—Palmarosa and ginger-grass, geraniol and acetate, geranium.

Modifiers.—Bromstyrole, ionone, spike, heliotropin.

Sweeteners.—Bergamot, lemon, petitgrain, bois de rose, terpineol.

Fixers.—Canada balsam, musks, vetivert, santal, incense, tolu.

Verbena, No. 1296.

100	Verbena oil—genuine.
200	Citronella oil—Java.
200	Bois de rose oil.
200	Geranium oil—Algerian.
10	Vetivert oil.
40	Sandalwood oil—E.I.
50	Canada balsam.
30	Musk ketone.
70	Petitgrain oil.
100	Lemon-grass oil.
1000	

Verbena, No. 1297.

200	Lemon-grass oil.
200	Citronella oil—Ceylon.
100	Geraniol.
100	Phenylethyl alcohol.
100	Ginger-grass oil.
20	Bromstyrole.
30	Ionone for soaps.

Verbena, No. 1297 (*continued*).

100	Lavender oil—spike.
50	Musk residues.
100	Terpineol.
1000	

VIOLET.

Bases.—Ionones.

Blenders.—Cedarwood, orris, heliotropin.

Modifiers.—Cananga, santal, aubepine, bromstyrole, methyl octine carbonate, atlas cedar.

Sweeteners.—Bergamot, geranium, bois de rose, benzyl acetate, cassia, sassafras.

Fixers.—Musks, vetivert, styrax, Peru balsam, benzoin, civet.

Violet, No. 1298.

200	Ionone for soaps.
200	Methyl ionone for soaps.
70	Geranium oil—Algerian
90	Cananga oil.
10	Orris concrete.
20	Vetivert oil.
150	Atlas cedar oil.
40	Benzoin R.
60	Peru balsam.
50	Musk xylene.
100	Heliotropin.
5	Civet absolute.
5	Methyl octine carbonate.
1000	

Violet, No. 1299.

200	Ionone residues.
50	Musk residues.
200	Cedarwood oil.
10	Styrax.
200	Terpineol.
50	Benzyl acetate.
200	Linalol.
20	Anisic aldehyde
20	Cassia.
50	Heliotropin.
1000	

The above compounds may be used as much as price will allow. For strength it may be necessary to employ 2 per cent, but about 1 per cent will generally be found ample.

Antiseptic and Medicated Soaps are made up with all kinds of medicaments, such as iodoform, thymol, phenol, betanaphthol, sulphur, etc. Many of the essential oils used in perfuming the soaps are highly antiseptic. In order to judge their antiseptic value, Cavel[1] studied their action on ordinary beef-tea which he had previously infected with water taken from the collecting tank of a sewerage system. He determined for the following volatile oils, the dilution per 1000, at which they no longer showed antiseptic value. It will be noted that phenol was 5·6 and is therefore a long way down the list :—

Thyme	0·7	Peppermint	2·5
Organium	1·0	Rose geranium	2·7
Sweet orange	1·2	Vetivert	2·7
Verbena	1·6	Bitter almond	2·8
Cassia	1·7	Eucalyptus	2·25
Rose	1·8	Ganetheria	3·0
Clove	2·0	Palmarosa	3·1
Spike	3·5	Lavender	5·0
Star anise	3·7	Balm	5·2
Orris	3·8	Ylang-ylang	5·6
Ceylon cinnamon	4·0	*Phenol*	5·6
Canadian snake root	4·0	Fennel—Sweet	6·4
Birch	4·1	Lemon	7·0
Anise	4·2	Sassafras	7·5
Rosemary	4·3	Limes	8·4
Cumin	4·5	Angelica	10·0
Neroli	4·75	Patchouli	15·0

A highly antiseptic perfume, therefore, may be compounded on the following lines :—

[1] "Comptes Rendus," 166 (1918), 827. Compare also the work of Bryant, "Perfumery and Essential Oil Record" (1924), 426.

No. 1300.

50	Thyme oil.
100	Cassia oil.
100	Clove oil.
50	Eucalyptus oil.
200	Rose geranium oil
20	Vetivert oil.
80	Rosemary oil.
200	Lavender oil.
200	Lemon oil.
1000	

Perfuming Boxes.—When packing wrapped soap some makers spray the boxes with perfume—an example of which is given :—

No. 1301.

30	Bergamot oil.
40	Geranium oil—Algerian.
30	Rose absolute.
10	Jasmin ,,
20	Tuberose ,,
5	Oakmoss, colourless.
20	Benzyl cinnamate.
20	Coumarin.
10	Musk ambrette.
100	Tincture of civet, 3 per cent.
715	Tincture of benzoin (10 per cent).
1000	

CHAPTER X.

TOBACCO FLAVOURS.

1. Origin of tobacco. Plant varieties grown. Cultivation. Curing. Prizing. Constituents.
2. Manufacture. Excise restrictions. Cigars. Cigarettes. Tobacco. Snuff. Including perfume and flavour formulæ.
3. Tobacco duties and statistics.

THE use of tobacco originated in America, and the name is probably derived from the original word used to describe the pipes employed by the Carib Indians for smoking the weed. It was introduced into Western Europe about 1500, first into Spain and subsequently into England by Sir Walter Raleigh in 1589. Despite the opposition against its use by Royalty and religious dignitaries, the habit spread rapidly to the Orient and thence to the East. To-day the manufacture of cigarettes and tobacco is one of our important industries, and the revenue obtained through its large consumption is of considerable assistance in helping the Chancellor of the Exchequer to balance his budgets. The tobacco industry may be divided broadly into two stages :—

1. The cultivation of the plant, together with drying, curing, prizing, etc.

2. The conversion of the leaf into tobacconists' commodities, involving the perfuming or flavouring of the imported raw material.

The Plant.—The tobacco plant thrives best in the tropics, and is cultivated particularly in Cuba, Central America, Borneo, Sumatra, and the Philippines. It can be grown also in temperate countries and might even flourish in this country were it not for the restrictions placed upon its cultivation by the Excise authorities. The only place of note where English cultivation has proved successful is situated at Crookham in Hants where the leaf has been grown since 1910. There are some 10 to 15 acres yielding a crop having an average value of £4000. The plant is a member of the N.O. Solanaceæ, and the genus *Nicotiana* consists of several species, of which the following are of importance :—

N. tabacum, L., is indigenous to many parts of South America. It attains a height of five or six feet and develops large ovate or lanceolate leaves. The flowers are pale pink, tubular or bell-shaped. This species yields the common Virginian tobacco of commerce. When fresh the odour of the plant is narcotic, its taste is nauseous and bitter. The characteristic tobacco smell is developed in the course of curing, etc.

N. rustica, L., is cultivated in Southern Europe, Turkey, and the Levant. The plant seldom exceeds two or three feet in height and its leaves are roundish ovate. The flowers are green, and the flavour after curing is much milder than the above. The leaves constitute the raw material for Turkish and Syrian cigarettes. It burns too rapidly for use in pipe tobacco.

N. Persica, Lindley, is grown mainly in Persia. The leaves of this species are oblong spathulate and the flowers white and aromatic. It constitutes the raw material for the tobacco of Shiraz.

N. nepanda, Willd., is cultivated principally in Havana, where it is used in the manufacture of a special variety of cigar.

N. multivalvis, Lindley, and *N. quadrivalvis*, Pursh, are also grown for special purposes.

N. acuminata, Graham, is cultivated in the mountainous districts of Northern Syria. The plant is a small one, seldom exceeding a few inches in height, and contrary to the usual practice of cultivators, is allowed to flower. The whole plant above ground is employed and is known as **Latakia.** Its peculiar odour and characteristic flavour is said to be due to the use, during curing, of a fuel consisting largely of dried camel dung.

Cultivation.—Tobacco, like many other substances, varies according to the soil upon which the plant is cultivated. The best results are obtained from well-drained ground rich in organic constituents. Sheltered positions are chosen to prevent the laceration and twisting of the leaves by the wind. The plants are raised from seed, sown in nursery beds during early spring. Those which have developed sufficiently are transplanted to the open fields about two months after sowing—wet weather being preferred. They are set out in rows and the ground requires frequent hoeing to keep down weeds, etc., and allow the plant to grow healthily. After seven or eight weeks the flower buds appear and are at once removed to ensure a finer development of leaf structure. Leaves which are near the ground as well as those at the top of the stem are removed—the number left (from 10 to 20) being judged by the grower to yield a finer crop. Ten to twelve weeks after planting the organism ripens, which is evidenced by the development of a yellowish-green colour. A resinous substance exudes from the leaves, which sometimes become mottled with yellowish spots. At this period the ripest plants are harvested, and cloudy weather is, if possible, chosen for the purpose. The leaves are sometimes removed from the stem but the commoner practice is to cut the stem near the ground and to place it on one side in the sun to wilt. The best quality leaves, known as "first brights," are taken to the barn on the stem which is split down the centre to within a few inches of the ground. They are thus "straddled," which preserves the leaves in the best condition.

Curing.—Tobacco, like vanilla, owes its characteristic odour and flavour to the curing process, which probably results in the action of some enzyme on a glucoside present in the plant. Two curing processes are employed, and the choice depends upon whether the leaves are pale or dark. If the former, they are "sun-cured." If the latter, they are cured by fermentation.

The sun-curing process is effected by one of two methods. The leaves are either (1) exposed to the sun at a temperature of about 22° C. for four or five days and afterwards hung in well-ventilated barns until soft and ready for packing, or (2) placed in buildings artificially heated where the temperature is gradually raised from 33° C. to 77° C. The control of the temperature requires very skilled judgment, the object being to turn the leaves a good yellow and then fix the colour. When the process is completed the leaves are damped and stripped from the stem. In wet weather the atmosphere is sufficiently moist to dispense with damping. The leaves are subsequently graded and packed.

The fermenting or sweating process is employed for curing most of the tobacco exported to Europe. The stems are hung in barns and the temperature raised quickly to about 80° C. This is maintained for four or five days until the leaves are quite dry and brittle. The doors of the barn are opened on a damp day when the leaves absorb moisture and become quite pliable again. They are then stripped from the stem and sorted, being subsequently bundled into twenties or thereabouts and heaped together on the floor. According to Tanner [1] the fermentation process commences at this stage. The temperature within the heap gradually rises until it reaches 55° C. when the heap is pulled to pieces to prevent overheating and the heap reformed. The tobacco assumes a uniformly brown tint in about one month, when the process is completed.

Prizing.—The bundles of cured tobacco leaf are now so arranged that they can be pressed by machinery into hogsheads of about 1000 lbs. Too great pressure causes blackening of the leaf and must be avoided. The object of prizing in standard weights is to facilitate calculations and examination in bulk. Tanner says that tobacco is

[1] "Tobacco," p. 40. Isaac Pitman & Sons.

sometimes "improved" at this stage by the addition of molasses, rum, vanilla, etc.

Constituents.—The active principle of tobacco is a liquid volatile alkaloid named *Nicotine* and discovered in 1828 by Posselt and Reimann. Albumin, gums, and resins are also present. An essential oil is present in cured tobacco. In 1899 Schimmel & Co. distilled 15 kg. and obtained a yield of 6 grams of a thick balsamic dark brown oil having an odour of camomile. When tobacco is smoked this volatile oil doubtless undergoes a certain amount of decomposition. Thoms[1] obtained from 20 kg. a yield of 75 grams of an ethereal oil which contained a phenol and probably furfurol. By means of the volatile solvent process Halle and Pribram[2] obtained a yield of 0·047 per cent of a yellowish oil having an overpowering odour of tobacco. Iso-valeric acid and iso-butyl acetic acid were identified as constituents.

Manufacture.—Since the sale of tobacco yields such a handsome return to the State in the form of duty, it naturally follows that the Excise authorities keep a watchful eye on the production of the finished article. Two kinds of factories are in operation :—

1. *Excise factories*, in which *duty-paid* tobacco only is manufactured under excise supervision. The higher grade products are made here.

2. *Bonded factories*, in which the finished tobacco is prepared and taxed when issued for sale. These premises are strictly controlled by customs' officials, and the use of heavy sweetening materials is permissible only in them.

The use of flavours or perfumes is allowed in either kind of factory, and it is on the composition of these that a manufacturer often relies for the popularity of his brands. When preparing a new flavour it is always desirable to

[1] "Chem. Zeitung.," 23 (1899), 852. Through Gildemeister and Hoffmann, "Volatile Oils," III., 583.

[2] "Report" of Schimmel & Co., October, 1914, 44.

consult the Excise officer and obtain his permission, especially in view of the stringency required by the law. In order to save the time of the tobacco chemist, it seems desirable that a note should be made of those substances *prohibited* by the Tobacco Act of 1842. These are: sugar, treacle, molasses, honey-combings or roots of malt, ground or unground rooted grain, unground chicory, lime, sand (not tobacco sand), amber, ochre or other earth, sea-weed, ground or powdered wood, moss or weeds, or any leaves or any herbs or plants (not being tobacco leaves or plants). Antiseptics other than *acetic acid*, added colouring matter, any substance imitating tobacco as an *internal wrapper*.

The following substances are *allowed* in the manufacture of tobacco :—

1. Acetic acid.

2. Essential oils dissolved in spirit for flavouring *cut* tobacco.

3. Tonka beans up to 3 per cent and orris-root up to 2 per cent for scenting *snuff*. (This applies to manufacturers only and not to dealers and retailers.)

In amplification of this it will be as well to state that the author has found the Board of Customs and Excise to offer no reasonable objection to any aromatic substance which is readily volatile and does not appreciably increase the weight of the finished product.

Thus alcoholic tinctures of vanilla, orris and tonquin bean have been approved, whereas resinous tinctures such as benzoin, styrax, tolu and Peru balsam have been objected to. Synthetics such as coumarin, vanillin, heliotropin, the rose alcohols and the majority of the essential oils have been freely approved, but from conversations with the Government chemist, it would appear that high-boiling synthetics such as benzyl benzoate and ethyl phthalate might be barred. Liquorice can of course be used only in Bond. The Tobacco Act of 1900 restricts the amount of oil (fixed such as olive) to 4 per cent. This is used mainly in roll tobacco.

Cigars.—The finest quality leaf for the manufacture of cigars is grown in the Vuelto-Abajo district of Cuba. This is situated close to Havana where the best-known brands are produced. Other grades of tobacco are imported from the Philippines and the Islands of the Malay Archipelago and these are well suited for medium quality cigars.

The cured leaf is damped to make it pliable. This enables the operator to more easily remove or "strip" the midrib, which is subsequently used in snuff manufacture. The "stripped" leaf is now graded according to which part of the cigar it will ultimately form—as for instance—"Wrappers" for the outside finish, "Bunch wrappers and Fillers" for the inside. The leaf is now sprayed with perfume and generally all odours are of the cascarilla-coumarin type. Weak alcohol is employed as solvent which is sometimes supplemented with small quantities of brandy or rum. An example is given :—

No. 1302.

20	Cascarilla oil.
30	Cinnamon leaf oil.
100	Vanilla extract, 10 per cent.
15	Coumarin.
5	Rose otto.
10	Santalwood oil.
70	Brandy.
750	Spirit.
1000	

This type of flavouring is applicable to Havana cigars, but is supplemented with traces of cinnamon bark oil for Manila cigars. The finished cigar is hand rolled, sorted, labelled, and packed. Cedarwood boxes were used for this last purpose, but to-day *Cedrela wood* [1] is generally preferred. This has a pleasant cedar-like odour which is often improved by added perfume sprayed on the box before the cigars are inserted. Such a perfume may be prepared as follows :—

[1] Consult Vol. I.

No. 1303.

5	Cedarwood oil.
2	Geranium oil—Algerian.
1	Patchouli oil.
2	Sandalwood oil.
1000	Alcohol.
1010	

Cigarettes.—The cured tobacco is damped to make it pliable, and in the case of Virginia leaf the midrib is removed as above described, while in the Turkish, this is so small as to be unnecessary. The leaf is then passed through a cutting machine adjusted to yield very thin strips. In the case of the Virginian leaf the tobacco is panned or stoved which serves the dual purpose of developing the flavour and removing excessive moisture. This requires expert attention for good results. In the case of Turkish leaf, this part of the process is unnecessary since the delicate flavour would be injured. The tobacco now requires to be perfumed before the hands or machines turn out the finished cigarette. The perfumes are blended on the following lines :—

Virginian—First Grade, No. 1304.

70	Coumarin.
20	Rose otto.
10	Clove oil.
80	Lavender oil.
40	Bergamot oil.
30	Cascarilla oil.
100	Sweet orange oil.
400	Geranium oil.
50	Phenylethyl valerianate.
100	Orris tincture.
40	Vanilla absolute.
60	Tonka bean absolute.
1000	

Virginian—Second Grade, No. 1305.

50	Coumarin.
20	Sweet orange oil.
30	Bergamot oil.

30	Lemon oil.
20	Phenylethyl valerianate.
5	Cassia oil.
50	Geranium oil.
15	Clove oil.
30	Tonka bean tincture.
250	Tincture of vanilla.
500	Tincture of orris.
1000	

Turkish, No. 1306.

5	Rose otto.
9	Geranium oil—Algerian.
5	Orange blossom absolute.
3	Tuberose absolute.
2	Jasmin ,,
8	Lavender oil.
2	Patchouli oil.
1	Methyl phenylacetate.
5	Tonka absolute.
160	Tincture of vanilla.
800	Tincture of orris.
1000	

Egyptian, No. 1307

5	Neroli oil.
35	Jasmin absolute.
10	Cassie ,,
10	Rose ,,
240	Tincture of vanilla.
200	Tincture of tonka
500	Spirit.
1000	

Tobacco.—When the leaf is imported the moisture content seldom exceeds 10 per cent. This is not sufficient, and since the law allows a maximum of 32 per cent, the leaf is damped. This is often carried out by blowing steam into the loosened bundles of tobacco. With the exception of "Bird's Eye" the midribs of the leaves are removed as soon as they become pliable. The perfume is sprayed on and evenly distributed by turning the leaves over. The leaf is now pressed through a cutting machine which is adjusted for fine, medium, or coarse cut as desired. The drying and developing of the flavour is carried out as indicated above by panning or stoving. The length of time allowed for this is determined by the type of tobacco being manufactured: for instance, shag and Cavendish are allowed to remain on the hot plate longer than flake. Some of the stronger tobaccos are darkened by the addition of olive oil before pressing between hot plates. Pigtail and twist are made from such grades which are eventually spun on special machines. Rum and extract of liquorice are generally added to improve the flavour, since these tobaccos are principally chewed. Plug, cake, and bar tobacco are made by pressure of the leaf in special machines.

The flavours employed for the various types are prepared very much on the basis of coumarin, nutmeg, cascarilla, clove, vanilla, and valerian. The stronger the tobacco, the higher the proportion used. In the "chewing" varieties, flavours such as aniseed and caraway are common. A formula illustrative of each type is given:—

Flake, No. 1308.

50	Coumarin.
20	Heliotropin.
20	Vanillin.
150	Sweet orange oil.
20	Cassia oil.
30	Clove oil.
30	Rose otto.
50	Rhodinyl valerianate
50	Cascarilla oil.
80	Nutmeg oil.
500	Tincture of tonka.
1000	

Shag, No. 1309.

100	Coumarin.
100	Cassia oil.
200	Nutmeg oil.
50	Clove oil.
50	Geranium oil—Algerian.
50	Cascarilla oil.
50	Peru balsam oil.
100	Phenylethyl valerianate.
100	Tincture of vanilla.
200	Tincture of tonka.
1000	

Roll (made in Bond), No. 1310

50	Coumarin.
30	Anethol.
70	Carvone.
20	Phenylethyl valerianate.
30	Orange oil.
600	Rum.
200	Liquorice, liquid extract.
1000	

Snuff.—Two distinct kinds are manufactured.

1. *Dry* from midribs.
2. *Wet* or *moist* from midribs, small leaves and waste.

The former is prepared by damping down the raw materials and placing them aside in bins to ferment. Sometimes alkaline salts are dissolved in the water used for damping but the percentages must be kept within prescribed limits. In certain kinds of dry snuff the fermented mass is subjected to "toasting" in special furnaces and is subsequently ground.

The latter is prepared in a similar manner, excepting that the temperature during fermentation is not allowed to exceed 55° C. and the mass is only completely cured after several weeks. It is subsequently ground.

All snuffs, excepting Welsh and Irish, are perfumed—one well-known brand owes its distinctive odour to a liberal use of bergamot oil. An example follows :—

No. 1311.

100	Coumarin.
100	Lavender oil
400	Bergamot oil.
100	Geranium oil.
100	Nutmeg oil.
50	Cinnamon leaf oil.
50	Cascarilla oil.
100	Vanilla essence.
1000	

Tobacco Duties.—According to the Finance Act of 1927 these are as follows :—

1. *Tobaccos imported and unmanufactured.*—Containing 10 lbs. or more of moisture in every 100 lbs. weight thereof.

	s.	d.
Unstripped (per lb.)	8	10
Stripped (per lb.)	8	10½
Containing less than 10 per cent of moisture:		
Unstripped (per lb.)	9	9½
Stripped (per lb.)	9	10
Tobacco manufactured :—		
Cigars (per lb.)	16	10
Cigarettes (per lb.)	13	7
Cavendish or negrohead (per lb.)	12	10
,, in Bond (per lb.)	11	2½
Other manufactured tobacco (per lb.)	11	2½
Snuff containing more than 13 per cent moisture (per lb.)	10	7
Snuff not containing more than 13 per cent moisture (per lb.)	12	10

2. *Tobaccos grown in the U.K. and unmanufactured.*

Containing more than 10 per cent moisture (per lb.)	6	7½
Containing less than 10 per cent moisture (per lb.)	7	4⅜
Tobacco manufactured :		
Cavendish or negrohead in Bond (per lb.)	8	7⅜

3. *Drawback per pound under* 1 *and* 2.	s.	d.	s.	d.
Cigars	10	$0\frac{1}{2}$	7	$8\frac{1}{2}$
Cigarettes	9	10	7	$6\frac{1}{2}$
Cut roll—cake or other manufactured tobacco	9	$6\frac{1}{2}$	7	4
Snuff (not being offal snuff) . . .	9	$3\frac{1}{2}$	7	$1\frac{1}{2}$
Stalks, shorts, or other tobacco refuse including offal snuff	9	$0\frac{1}{2}$	6	$11\frac{1}{2}$

The emergency Budget of 1931 increased the above duties by 8d. per pound.

Production Statistics.—In the following figures for 1907 and 1924 the most notable increase is that of cigarettes. In the former year Ireland was included but excluded in the latter, which thus covers Great Britain only. The increase in the rate of duty between these two specific years should not be overlooked. In 1907 it was 3s. 8d. per lb. and in 1924 8s. 2d. per lb.

Products.	1907.		1924.	
	Quantity.	Value.	Quantity.	Value.
	cwts.	£	cwts.	£
Cigars	33,300	1,602,000	12,800	1,585,000
Cigarettes	267,200	8,195,000	823,200	62,981,000
Cavendish or negrohead manufactured in Bond .	27,800	361,000	31,900	1,038,000
Snuff for human use . .	14,200	307,000	4,600	219,000
Other tobaccos . . .	627,500	12,987,000	463,900	27,319,000
Offal snuff, shorts, smalls and stalks—sold . .	38,800	343,000	84,500	82,000
All other products . .	—	75,000	—	17,000
Total value of goods made	—	23,870,000	—	93,241,000

These figures are taken from the "Tobacco Year Book, 1928," which contains much valuable data relative to the industry.

CHAPTER XI.

FLORAL CACHOUS.

1. Early types of mouth pellets.
2. Lozenge-made cachous—standards—base—bouquet and floral flavours with formulæ—process.
3. Tablet-made cachous—base—manufacturing process.

THE perfuming of the breath by means of mouth pellets is of comparatively recent origin. The ancient peoples knew the flavouring value of several of the plants and their by-products, but utilised them principally as flavours for wine. It is doubtful, however, whether they appreciated their value so much in this direction as they did in the preparations of incense, perfumes, and fumigants.

Mouth pellets in their present form are said to have originated in Italy. According to an early English book[1] there was evidently an attempt to make a cachou by using tragacanth as the base and perfuming it with essential oils and grain musk. These perfumed pellets were very much liked by heavy smokers. An improvement was made in their production by utilising a mixture of liquorice and sugar as the base and spices as well as essential oils as the flavour. It was customary to make them very much as pills are made to-day and to give them a silver or gilt finish. The following formula will illustrate the type:—

No. 1312.

10	Peppermint oil.
10	Orange oil—sweet.
10	Lemon oil.
15	Neroli oil.
5	Bergamot oil.
50	Cinnamon bark, in powder.

[1] "The Toilet of Flora," 1775.

50	Cloves, in powder.
100	Vanilla beans, ground.
150	Orris, in powder.
200	Powdered sugar
400	Extract of liquorice.
q.s.	Mucilage of acacia.
1000	

To-day these have fallen very much out of favour owing to the more attractive flavours and colours of the modern cachou. These are now manufactured either as lozenges or tablets, the former possessing the great advantage of toughness. They therefore retain the flavour to the last thin wafer and do not disintegrate rapidly as tablets are prone to do.

Lozenge-made Cachous.—As previously indicated by the author,[1] the standards for a really good cachou are as follows :—

1. A smooth touch to the tongue.
2. A toughness sufficient to prevent rapid disintegration.
3. A delicate and attractive colour.
4. A persistent flavour approximating to the fragrance of the natural flower.

In order that these characters shall be evident in the finished product, the following points require to be carefully noted : Roughness on the surface of a cachou is generally caused by a too coarse sugar powder. The finest icing obtainable only should be used, and this is produced by repeated grinding and sifting through a fine mesh in a Gardner or other machine. The sugar should all pass through a 160 sifter. The sugar base may be improved, and at the same time slightly cheapened, by the addition of 10 per cent. of starch. Toughness is imparted by the use of tragacanth. Acacia alone is very hard and inclined to be brittle. By using a quarter the weight of tragacanth the necessary quantity of acacia is reduced to a minimum. About 4 per cent of acacia and 1 per cent of tragacanth is a reasonable medium. A solution of glucose, 1 in 2, is

[1] "Chemist and Druggist" (1925), 154.

used to form the mass, and generally 10 to 15 per cent will be found sufficient. The formula for the cachou-base will now read :—

No. 1313.

900	Finest icing sugar (160 mesh).
100	Starch.
40	Acacia, in powder.
10	Tragacanth, in powder.
q.s.	Glucose solution, 50 per cent.
1050	

The colour of the product will naturally be as near as possible to that of the natural flower, and several delicate shades are manufctured in Great Britain which are especially prepared for use in foodstuffs, and contain an insignificant percentage of arsenic. For instance: Carnation or rose may be coloured pink with a solution of carmoisine, rhodamine, carmine, etc.; jasmin may be coloured yellow with tartrazine; violet or lavender may be tinted a heliotrope shade with methyl violet solution. The exact tint required is a matter of personal taste, and those desiring to experiment should consult Volume I, where a detailed list of the many dyestuffs manufactured in this country will be found. The best procedure is to make a standard strength solution, say 2 per cent, and, after having found by experiment the quantity of basic colour required, shade or "top" it with another. For instance, when colouring rose cachous many operators prefer a yellowish-pink tint, which, in their opinion, is a nearer imitation of the colour of a certain type of rose. Carmoisine would be used as the basic colour, and the shading could be conveniently accomplished with tartrazine.

The last character is generally the most important one, and frequently the selling feature of the product. Many of the popular flavours have a basis of vanilla, cinnamon, and cloves, rounded off with rose, patchouli, musk, etc. Synthetic aromatic chemicals and natural isolates, when employed, should be used with much discretion, since they have generally a coarser flavour. They are best employed in small quantities to modify the flavours of other essential oils. An example of a popular type of cachou flavour is appended ; it will offer endless possibilities for slight modification to the experimenter :—

Bouquet, No. 1314.

1	Vanillin.
3	Coumarin.
1	Benzaldehyde.
1	Nutmeg oil.
2	Rose otto.
2	Cinnamon oil (bark).
2	Cassia oil
8	Clove oil
10	Lavender oil.
10	Patchouli oil.
20	Musk tincture, 3 per cent.
40	Vanilla essence, 10 per cent.
100	

Dissolve the solids in the mixed liquids without the direct application of heat, and mature for at least one month before use. Employ $\frac{1}{10}$ per cent to $\frac{1}{4}$ per cent according to taste.

Other flavours having a distinct floral note may be prepared as follows :—

Carnation, No. 1315.

200	Iso-eugenol.
200	Clove oil.
50	Ylang-ylang oil.
30	Neroli oil.
20	Rose otto.
300	Benzoin tincture, 10 per cent.
150	Musk tincture, 3 per cent.
40	Heliotropin.
10	Vanillin.
1000	

Hawthorn, No. 1316.

300	Anisic aldehyde.
50	Almond oil—bitter S.A.P.
50	Neroli oil.

Hawthorn, No. 1316 (*continued*).

100	Geranium oil—Algerian.
300	Benzoin tincture, 10 per cent.
140	Musk tincture, 3 per cent.
10	Orris oil—concrete.
30	Coumarin.
20	Vanillin.
1000	

Heliotrope, No. 1317.

200	Heliotropin.
20	Vanillin.
50	Almond oil—bitter S.A.P.
100	Geranium oil—Algerian.
80	Clove oil.
50	Peru balsam oil.
300	Vanilla essence, 10 per cent.
200	Benzoin tincture, ,,
1000	

Jasmin, No. 1318.

20	Jasmin absolute.
30	Rose ,,
50	Benzyl acetate.
100	Orange oil—sweet.
50	Neroli oil.
50	Bois de rose oil.
700	Vanilla essence, 10 per cent.
1000	

Rose, No. 1319.

100	Rose otto—Bulgarian.
100	Geranium oil—Algerian.
100	Phenylethyl alcohol.
150	Clove oil.
20	Cassia oil.
30	Patchouli oil—English.
200	Musk tincture, 3 per cent.
100	Benzoin tincture, 10 per cent.
200	Vanilla essence, ,,
1000	

Many rose cachous are perfumed with the otto only but they lack body. Rose, No. 1090, would be better.

Violet, No. 1320.

200	Methyl ionone.
100	Santalwood oil.
100	Clove oil.
20	Ylang-ylang oil.
30	Bergamot oil.
50	Geranium oil—Algerian.
20	Orris oil—concrete.
30	Heliotropin.
450	Vanilla essence, 10 per cent.
1000	

Having now obtained all the data to proceed, it only remains to describe briefly the methods of manufacture. Icing sugar easily becomes damp unless very carefully stored. Should it become caked into lumps, coarse and then fine sifting is necessary. Providing it is purchased of the requisite fineness, the dry, raw material need not be put through a sifting machine. It is generally desirable to put it through a sieve of about 20 mesh when introducing it into the machine or mortar; this ensures the absence of small lumps, which become particularly evident after the base has been coloured. The other solids are passed through the same sieve, the flavour and colour added, and finally the excipient. The mass is allowed to rotate in the machine, or is worked in the mortar, until a plastic substance is obtained. This is then rolled out by hand with a roller and board, or for large operations by machine, sufficient potato starch being employed to prevent the paste adhering to the board. When the correct thickness has been obtained, it is cut up into different shapes and placed on trays to dry (without artificial heating). The cachous are subsequently brushed to remove excess of farina and packed.

Tablet-made Cachous.—The details already given for perfume and colour also apply to the manufacture of tablets, but the cachou base and process of necessity differ. The basis of the cachou is again icing sugar in fine powder, to which is added varying proportions of lactose. This is employed because it is an excellent absorbent for essential oils, and when large quantities are used for flavouring it prevents the tablets spotting and becoming soft after compression. Powdered acacia is generally used to give the necessary binding, and this is sometimes supplemented by the addition of tragacanth. A generally useful base can be made from these ingredients as follows :—

No. 1321.

900	Icing sugar.
100	Lactose.
20	Acacia.
10	Tragacanth.
q.s.	Syrup.
1030	

The two gums may be varied according to whether the finished tablet is required to be harder or tougher. The manufacturing process is carried out by mixing together the powders and adding the necessary quantity of colours in solution. These are placed in a mixing pan, and sufficient syrup is added so that the finished mass makes a fairly stiff paste. This is then passed through a 12-mesh sieve and evenly distributed in thin layers over shallow trays. These are placed in tiers in a drying cupboard kept at a temperature of about 120° F. When the moisture has evaporated, the trays are removed and the granules again passed through a sieve of smaller mesh, say 16 or 20. From 1 to 5 per cent of talc is now mixed in with the granules ; this acts as a lubricant, yielding a smoother flow on the machine. The perfume is evenly distributed and the whole transferred, a few pounds at a time, to the hopper of the machine. For economical production a twenty-four punch rotary tablet machine of the Colton or Wilkinson type is employed, and the punches and dies adjusted to yield a tablet weighing 4 or 5 grains.

CHAPTER XII.

INCENSE AND FUMIGANTS.

1. Incense—ancient uses—joss-sticks.
2. Fumigating pastilles.
3. Perfumed incense.
4. Perfumed ribbon—cards—programmes.

THE burning of aromatic plants and their products has from time immemorial played an important part in religious ceremonies. The monuments of ancient Assyria and Egypt bear ample proof of this by the numerous sculptures and paintings appearing on them. There are further references to this practice in the writings of the Scriptures. For instance, in Exodus xxx. 1 : "And thou shalt make an altar to burn incense upon." Other references are to be found in Exodus xxx. 7, 8, 34 ; 2 Kings xxii. 10, 11 ; xxiii. 5. The Egyptians burned the incense in censers and used principally myrrh, frankincense, and a specially blended mixture of sixteen ingredients called *Kaphi*. While this custom has been abandoned by many churches because of the great esteem in which it is held by the heathens, it still finds a wide use by the Roman Catholic and Greek churches. The principal form in which incense is burnt in the East to-day is as joss-sticks. These are fashioned somewhat like a candle and are said to be made principally of powdered santalwood (both East Indian and West Australian) mixed with swine's dung. The incense burned in the European churches to-day appears to consist mainly of olibanum : some specimens contain a little charcoal, benzoin, and storax.

Aromatic substances are nowadays burnt also as fumigants in sickrooms and as perfumes for apartments. Powdered woods and spices are used, but where possible they are replaced by essential oils and charcoal. As is well known, the combustion of aromatic woods gives rise to empyreumatic substances which have a deleterious influence on the odours of the other ingredients. Charcoal, on the other hand, possesses none of these disadvantages, and when lighted continues to glow—the heat given off volatilising the aromatic essential oils and gums. Saltpetre is often added to assist combustion.

Fumigating Pastilles.—Amongst the substances employed in the manufacture of fumigating pastilles are the following :—

Siam benzoin.
Tolu balsam.
Peru balsam.
Labdanum.
Cascarilla oil.
Sandalwood oil.
Clove oil.
Cassia oil.
Patchouli oil.
Vetivert oil.
Grain musk.
Civet.

The pastilles are made by powdering the gums, adding the charcoal and potassium nitrate, spraying on the essential oils and finally massing with a mucilage of either gum acacia or tragacanth. An example follows :—

No. 1322.

100	Siam benzoin.
50	Tolu balsam.
700	Charcoal.
50	Saltpetre.
50	Sandalwood oil.
15	Patchouli oil.
30	Cascarilla oil.
5	Grain musk.
q.s.	Mucilage of acacia.
1000	

Press the mass into conical moulds.

Perfumed incense is frequently sold in powder form and does not contain olibanum, since the smallest percentage is noticeable. In order to obtain new odour notes, perfumers resort to the use of many of the modern synthetics as well as spices such as cardamon and cubebs. The essential oils and gum-resins are added in such proportions that the finished powder is damp and adherent. It can then be easily pressed into a conical shape, placed on an ash-tray and lighted. An example of this type is given :—

No. 1323.

150	Siam benzoin.
300	Sandalwood, in powder
150	Cascarilla, in powder.
120	Willow charcoal.
30	Saltpetre.
40	Cardamons, in powder.
35	Cubebs, in powder.
10	Myrrh, ,,
5	Grain musk.
30	Bergamot oil.
10	Patchouli oil.
20	Neroli oil.
15	Cassia oil.
5	Clove oil.
30	Peru balsam.
10	Orris oleo-resin.
30	Iso-butyl cinnamate
10	Methyl ionone
1000	

Perfumed ribbon is prepared by immersing rolls of very thin wick in saturated solution of saltpetre and subsequently perfuming. The ribbon is then burned in a special lamp or is often supplied in a box made for the purpose. A suitable perfume is made as follows :—

No. 1324.

30	Musk ambrette.
30	Coumarin.
20	Vanillin.
50	Rose otto.
20	Jasmin absolute.
50	Vetivert oil.
300	Tincture of tolu, 10 per cent.
500	Tincture of benzoin, 10 per cent.
1000	

Perfumed cards are often used for advertising purposes and are better perfumed before printing. For this purpose the card in sheets is placed in a specially constructed chamber and the perfume volatilised at a low temperature from a shallow tray in the bottom. This method yields uniform results and is better than immersion, when the sheets are apt to crinkle or come out in streaks. The perfume chosen is generally the one being advertised when it should be prepared for the purpose in concentrated form. An example of lavender water is given :—

No. 1325.

50	Lavender oil—English.
150	Lavender oil—French.
200	Bergamot oil.
20	Thyme oil.
30	Rosemary oil.
20	Oakmoss absolute.
30	Patchouli oil.
25	Musk ambrette.
25	Coumarin.
450	Tincture of benzoin, 10 per cent.
1000	

Perfumed programmes may be treated like the latter but are frequently sprayed on the edges while they stand aside in piles. An example of an amber type is given :—

No. 1326.

200	Tincture of musk, 3 per cent.
50	Tincture of civet, ,,
250	Tincture of ambergris, ,,
25	Labdanum clair.
15	Oakmoss absolute decolorised.
20	Jasmin absolute.
40	Rose ,,
30	Musk ambrette.
40	Vanillin.
30	Benzyl iso-eugenol.
300	Tincture of benzoin, 10 per cent.
1000	

CHAPTER XIII.

SACHETS AND SOLID PERFUMES.

1. General notes, two types.
2. Sachet base with two examples.
3. Individual sachets with odour formulas.
4. Pot-pourri, olla-podrida.
5. Solid perfumes.

SACHET powders are most useful for placing amongst clothes and linen without any fear of damage. They are attractively produced by packing in silk or velvet envelopes, and when skilfully made the odour will last for years. The perfumer is somewhat limited in his choice of a dry odourous natural base, since many aromatic raw materials only retain their odour while fresh; notable exceptions amongst the flowers are lavender, clove, and rose; amongst the leaves: patchouli, orange, and lemon; amongst the roots: vetivert and orris; amongst the woods: sandal, cedar, and rosewood; amongst the seeds: ambrette, tonka, anise, and nutmeg; and amongst the barks: cascarilla, cinnamon, and cassia. In the case of the gum-resins all of these are available, and those which cannot be powdered may be rubbed in or sprayed on in alcoholic solutions. The crystalline synthetics could be employed direct, but it is generally better to use them in any added compound. The animal extracts are most successfully employed in the form of concentrated alcoholic extracts and are always used in the best quality sachets. In a few cases grain musk is added direct. Vanilla may be utilised either way.

There are two separate and distinct methods available for the production of sachets; the first by the use of one general powder base to which is added the distinctive floral compound; the second where the separate natural powder bases are chosen according to their odour and subsequently topped by a compound or suitable synthetics, natural isolates, and where price will allow—flower absolutes. Alternatively cheapness can be obtained by diluting the finished powder to price with maize starch.

A Sachet base for the former type is made by mixing the natural substances, previously powdered, in suitable proportions. Almost all of them are available in this state and are stocked by the largest wholesale houses. An example of this type is given :—

No. 1327.

200	Orris.
150	Sandalwood.
100	Cedarwood.
100	Rosewood.
70	Patchouli.
50	Vetivert.
80	Rose petals.
100	Lavender.
50	Ambrette seed.
30	Tonka beans.
59	Siam benzoin.
10	Clove.
1	Grain musk.
1000	

These substances are well mixed and passed through a coarse sieve twice. The base is stored until required in air-tight containers. When finishing off this base ready for packing there are two methods available which differ according to the finished odour desired. For instance, if the sachet is a lavender one, then the procedure would be according to this formula :—

No. 1328.

600	Sachet base.
350	Lavender flowers.
50	Lavender flower oil.
1000	

If the sachet, however, is to have an odour which cannot be enhanced by the further additions of natural aromatic powders, such as heliotrope, the procedure would be as follows :—

No. 1329.

950	Sachet base.
50	Heliotrope flower oil.
1000	

In this particular instance it would of course be possible to select harmonising ingredients, such as vanilla and benzoin, and add them as in the lavender example, but such a procedure would probably spoil the odour of the already matured flower oil compound.

Individual sachets can be compounded very much according to the fancy of the perfumer, the natural powdered substances being selected according to their harmonising qualities. A few standard examples are given :—

Carnation, No. 1330.

350	Orris.
200	Sandalwood.
120	Rose petals.
30	Tonka beans.
50	Siam benzoin.
200	Cloves.
10	Iso-eugenol.
5	Amyl salicylate.
1	Mace.
5	Terpineol.
10	Benzyl iso-eugenol
5	Vanillin.
10	Heliotropin.
3	Musk ketone.
1	Bromstyrole.
1000	

Chypre, No. 1331.

300	Sandalwood.
150	Rose petals.
50	Cedarwood.
100	Lavender flowers.
300	Patchouli leaves.
30	Vetivert roots.
20	Tonka beans.
15	Oakmoss absolute—green.
5	Ylang-ylang oil—Bourbon.
3	Sassafras oil.
2	Dimethyl hydroquinone.
1	Labdanum clair.
10	Castoreum extract, 3 per cent
4	Vanillin.
7	Heliotropin.
3	Musk ambrette.
1000	

Heliotrope, No. 1332.

350	Orris.
300	Rose.
100	Siam benzoin.
100	Tonka beans.
100	Heliotropin.
10	Vanillin.
15	Anisic aldehyde.
5	Neroli oil—bigarade.
5	Musk ketone.
10	Civet extract, 3 per cent.
5	Almond oil—S.A.P.
1000	

Jasmin, No. 1333.

700	Rosewood.
250	Orris.
30	Benzyl acetate.
10	Ylang-ylang oil—Bourbon.
2	Amyl cinnamic aldehyde.
3	Musk ketone
5	Civet extract, 3 per cent.
1000	

Lavender, No. 1334.

450	Lavender flowers.
200	Sandalwood.
100	Orris.
100	Tonka beans.
100	Patchouli.
20	Lavender oil—M.B.
2	Oakmoss absolute—green.
10	Vanilla extract, 10 per cent.
5	Petitgrain oil.
10	Bergamot oil.
3	Musk ketone
1000	

Orange Blossom, No. 1335.

600	Rosewood.
200	Sandalwood.
150	Orris.
20	Petitgrain oil—French.
2	Geranyl formate.
5	Benzyl acetate.
5	Cananga.
5	Terpeneol.
8	Methyl naphthyl ketone.
3	Musk ketone.
2	Orange blossom absolute.
1000	

Rose, No. 1336.

700	Rose petals.
50	Patchouli leaves.
30	Siam benzoin.
20	Clove.
150	Orris.
20	Rose geranium oil—French.
5	Rose otto.
15	Phenylethyl alcohol.
3	Musk ketone.
5	Ambergris extract, 3 per cent
2	Heliotropin.
1000	

Trèfle, No. 1337.

200	Sandalwood.
200	Orris.
300	Rose.
100	Lavender.
30	Patchouli.
20	Vetivert.
70	Tonka beans.
30	Benzoïn—Siam.
30	Amyl salicylate.
1	Oakmoss absolute—green.
1	Clary sage—concrete.
3	Ylang-ylang oil—Bourbon.
5	Jasmin, No. 1053.
10	Musk ambrette.
1000	

Violet, No. 1338.

400	Orris.
300	Sandalwood.
200	Cedarwood.
30	Vetivert.
20	Siam benzoin.
30	Methyl ionone.
1	Violet leaves absolute.
10	Heliotropin.
3	Jasmin, No. 1053.
6	Musk ambrette.

Pot-pourri differs mainly from the above in that the raw materials are mixed whole—i.e. *unground*. No particular type of odour is imitated other than a sweet persistent bouquet. The addition of a flower compound is entirely optional. An example follows :—

No. 1339.

400	Red rose petals.
100	Lavender flowers.
200	Coarse sandalwood.
50	,, orris rhizome.
30	Patchouli leaves.
10	Vetivert roots.

10	Tonka beans—broken
20	Cloves.
10	Cinnamon bark.
10	Allspice.
10	Mace.
50	Calamus root.
30	Benzoin—Siam.
20	Coriander seeds.
10	Rose artificial.
10	Neroli ,,
10	Jasmin ,,
10	Ambrone, No. 1007.
10	Heliotropin.
1000	

Olla-Podrida might be termed the "stock-pot" of the perfumery manufacturer. It consists of all the waste materials and spent plant and animal residues from which alcoholic extracts are prepared. These are made saleable by the addition of cheap herbs such as thyme, rosemary, lavender, and rose petals.

Solid Perfumes.—It is well known that the best way of presenting perfumes is in the ethyl alcoholic form, but owing to the high duty on this pure solvent perfumery chemists are always experimenting with a view to popularising cheaper products. A method which has recently suggested itself is that of using a fat or wax base as an inodorous vehicle. On the face of it No. 36 flower pomade would seem to be the ideal medium, but since it is produced from a mixture of two of lard to one of beef suet, it is naturally a rather greasy base. This can be lessened to some extent by making suitable additions of beeswax when the concentrated flower oil is added to the melted pomade as follows:—

No. 1340.

600	No. 36 rose pomade.
200	White beeswax.
200	Concentrated flower oil.
1000	

This makes a fairly satisfactory solid perfume but the objection of some greasiness is still present. With a view to the production of a suitable non-greasy product the author carried out a number of experiments and obtained completely satisfactory results by utilising a mixture of Japan wax and white beeswax together with ethyl phthalate and any fancied concentrated floral compound as follows :—

No. 1341.

200	White beeswax.
200	Japan wax.
400	Ethyl phthalate.
200	Concentrated flower oil.

By varying the proportions of wax and fixative, hard or soft products may be obtained, and the perfume base can, of course, be chosen according to the fancy of the perfumer.

CHAPTER XIV.

FRUIT FLAVOURS.

1. Natural fruit juices—preparation—yield.
2. Concentration—process and approximate yield.
3. Artificial fruit flavours. Components. Fourteen type formulæ.

WHOLLY artificial fruit flavours, however skilfully prepared, always lack that finish which characterises those containing a proportion of natural fruit juice. This should be borne in mind when preparing the flavours described below, and doubtless price will influence the proportion which may be subsequently added.

Fruit Juices.—The preparation of the natural juice involves the crushing of the fruits between stone rollers where metal is not allowed to come into contact with the product. (A reaction would take place between the acids present in the juice and the metal, forming soluble salts which might interfere with both taste and colour.) In some cases, notably those of pineapple and strawberry, the fresh fruit is crushed and the juice pressed out and filtered. In others, notably those of apples, plums, pears, and apricots, the flavour is much improved by fermentation which is effected before the pressure of the pulp. For this purpose from 2 to 5 per cent of sugar is added, and after inversion by the fruit acids, fermentation proceeds at a temperature of 22° to 30° Centigrade, the necessary time for complete development of the alcohol being from five to seven days. As the alcohol is formed, so is the pectin precipitated. This not only clarifies the juice but also much facilitates its filtration. Media sometimes used for filtration include, kaolin, kieselguhr, talcum, and asbestos. One-half per cent of skimmed milk is also said to be a useful addition. The fruit juice may now be sterilised to destroy bacteria and thus prevent deterioration. This is accomplished by heating the juice in a closed apparatus to about 82° C. for half an hour. Incidentally, this coagulates any albumin present and thus further facilitates clarification, which takes place in sealed containers. The use of organic substances, such as sodium benzoate, benzoic and salicylic acids, as preservatives is only allowed in certain countries. The conversion of the juice into a syrup by solution of about 60 per cent of sugar (13 sugar to 7 juice) is another method, not infrequently adopted because most juices are sweetened before being used.

The yield of juices for the fruits is approximately as follows :—

Apples .	65 per cent
Bilberries .	70
Blackberries	80
Cherries .	70
Currants, Black	70
„ Red	80
„ White	70
Gooseberries	70
Grapes .	75
Pears .	70
Raspberries	75
Strawberries	80

The concentration of fruit juices is really nothing more nor less than a fractional distillation *in vacuo*—the first runnings (about 10 per cent), containing the most volatile aromatic constituents, being added to the residues in the still. To make sure of the clarity of these concentrated juices, it is customary to add some alcohol to the still residues before the first fraction is added again. This precipitates any pectinous matter which is filtered out. The filtrate is transferred again to the still and the alcohol recovered. The first aromatic fractions are then added when a perfectly bright and clear concentrated product results. To obtain 1 litre of concentrated fruit juice the following approximate quantities must be taken :—

6	litres	Apple	juice.
20	,,	Apricot	,,
8	,,	Bilberry	,,
10	,,	Blackberry	,,
6	,,	Cherry	,,
10	,,	Cranberry	,,
8	,,	Currant	,,
6	,,	Gooseberry	,,
4	,,	Grape	,,
6	,,	Lemon	,,
5	,,	Mandarin	,,
6	,,	Mulberry	,,
4	,,	Orange	,,
6	,,	Pear	,,
20	,,	Peach	,,
6	,,	Pineapple	,,
10	,,	Plum	,,
10	,,	Strawberry	,,

Artificial Flavours are based very largely upon synthetics of a very volatile nature, and the lack of sustained taste on the tongue will be readily understood. It is therefore customary to use small quantities of other substances having necessarily no flavour relationship, but which act very much in the manner of a perfumery fixative. The most commonly employed substance is vanillin. Heliotropin and also coumarin have their similar uses. Glycerine is often used as a vehicle, an organic acid sharpens the taste and the diluent is generally alcohol.

Apple Components.—Acetaldehyde, amyl acetate, butyrate and valerianate, butyl aldehyde, butyrate, formate and valerianate, ethyl acetate, butyrate, malonate, propionate, nitrite and valerianate, ethyl œnanthate, chloroform, geranyl butyrate, iso-butyl acetate and valerianate, phenylethyl butyrate and valerianate, phenylglycol formate, vanillin, benzaldehyde, eugenol, clove oil and pimento oil, petitgrain oil, octyl and undecyl acetates.

Apple Base, No. 1342.

300	Amyl valerianate.
200	Ethyl malonate.
100	Acetaldehyde.
50	Chloroform.
45	Geranyl butyrate.
200	Ethyl acetate.
5	Vanillin.
100	Glycerine.
1000	

Apricot Components.—Acetaldehyde, amyl alcohol, acetate, butyrate and formate, anethol, benzaldehyde, chloroform, benzyl acetate, cinnamate, formate and propionate, ethyl acetate, butyrate, formate, cinnamate and valerianate, methyl cinnamate, ethyl œnanthate, phenylethyl acetate, butyrate and formate, gamma undecalactone, jasmin absolute, methyl salicylate, ethyl salicylate, vanillin, tartaric acid, pimento oil.

Apricot Base, No. 1343.

70	Amyl butyrate.
150	Benzaldehyde.
300	Ethyl butyrate.
200	,, valerianate.
50	,, salicylate.
30	,, œnanthate.
50	Chloroform.
10	Gamma undecalactone
10	Vanillin.
25	Petitgrain oil—French
5	Jasmin absolute.
100	Glycerine.
1000	

Banana Components.—Amyl acetate and butyrate, benzaldehyde, benzyl acetate, formate, propionate and cinnamate, cinnamon, clove, coriander, camomile, ethyl acetate, butyrate and sebacate, ethyl œnanthate, lemon, orange, petitgrain, eugenol, pimento, vanillin.

Banana Base, No. 1344.

300	Amyl acetate.
100	,, butyrate.
15	Benzaldehyde.
40	Benzyl propionate.
400	Ethyl butyrate.
100	,, sebacate.
20	Clove oil.
20	Petitgrain oil.
5	Vanillin.
1000	

Blackberry Components.—Amyl acetate, ethyl acetate, butyrate, benzoate and œnanthate, methyl salicylate, ionone, orris, vanillin, heliotropin, benzoic acid.

Blackberry Base, No. 1345.

400	Ethyl acetate.
100	,, butyrate.
200	,, benzoate.
100	,, œnanthate.
60	Methyl ionone.
40	,, salicylate.
50	Orris concrete.
10	Vanillin.
40	Benzoic acid.
1000	

Cherry Components.—Amyl alcohol, acetate, butyrate and formate, benzaldehyde, ethyl acetate, benzoate, butyrate, œnanthate and pelargonate, cassia, cinnamon, clove, benzoic acid, pimento, vanillin, petitgrain, ethyl cinnamate, glycerine, lemon, orange, gamma undecalactone.

Cherry Base, No. 1346.

50	Amyl formate.
50	,, butyrate.
300	Ethyl acetate.
400	,, benzoate.
100	,, œnanthate.
5	Cinnamon bark oil.
10	Clove oil.

Cherry Base, No. 1346 (*continued*).

20	Petitgrain oil.
5	Gamma undecalactone.
10	Vanillin.
50	Benzoic acid.
1000	

Gooseberry Components.—Acetaldehyde, amyl acetate and formate, benzoic acid, benzaldehyde, coumarin, ethyl acetate, butyrate, formate, benzoate and œnanthate, geraniol, lemon, clove, petitgrain, pimento, fennel, rose, sassafras, glycerine, succinic and tartaric acids.

Gooseberry Base, No. 1347.

50	Acetaldehyde.
200	Amyl formate.
300	Ethyl acetate.
200	„ butyrate.
100	„ benzoate.
20	Geraniol.
30	Succinic acid.
5	Sassafras oil.
5	Fennel oil.
10	Coumarin.
80	Glycerine.
1000	

Grape Components.—Acetaldehyde, amyl acetate and butyrate, cardamon, clary sage, chloroform, cinnamyl propionate, ethyl acetate, anthranilate, formate and œnanthate, diethyl succinate, methyl salicylate, benzoic, succinic and tartaric acids, octyl iso-butyrate and valerianate, rhodinol, mace, ethyl pelargonate, terpineol, vanillin, glycerine cognac (ethyl heptoate), clove, lemon, orange.

Grape Base, No. 1348.

50	Acetaldehyde.
50	Amyl butyrate.
50	Chloroform.

10	Clary sage.
400	Ethyl acetate.
200	„ œnanthate.
30	„ pelargonate.
50	Ethyl formate.
10	Methyl salicylate.
30	Succinic acid.
10	Cognac oil.
5	Octyl valerianate.
5	Vanillin.
100	Glycerine.
1000	

Melon Components.—Acetaldehyde, amyl acetate, butyrate and valerianate, benzyl acetone, ethyl acetate, butyrate, œnanthate, formate, pelargonate, capronate, sebacate and valerianate, eugenol, cassia, clove, pimento, vanillin, lemon, orange, glycerine, undecalactone.

Melon Base, No. 1349.

150	Ethyl acetate.
100	„ formate.
150	„ butyrate.
400	„ valerianate.
50	„ pelargonate.
4	Benzyl acetone.
5	Eugenol.
1	Gamma undecalactone.
100	Ethyl sebacate.
30	Lemon oil.
10	Vanillin.
1000	

Peach Components.—Amyl alcohol, acetate, butyrate and formate, benzaldehyde, benzyl cinnamate, acetaldehyde, butyric aldehyde, cinnamyl acetate, ethyl acetate, butyrate, cinnamate, formate, valerianate, œnanthate and sebacate, geranyl butyrate, iso-butyl cinnamate, methyl cinnamate and salicylate, phenylethyl acetate, butyrate and iso-butyrate, undecalactone, vanillin, lemon, orange, clove, pimento, cinnamon, cardamon, petitgrain.

Peach Base, No. 1350.

500	Gamma undecalactone.
150	Amyl acetate.
50	„ formate.
10	Benzyaldehyde.
40	Benzyl cinnamate.
50	Ethyl œnanthate.
50	„ butyrate.
50	„ valerianate.
100	Vanillin.
1000	

Pear Components.—Amyl acetate, formate and valerianate, ethyl acetate and butyrate, butyl butyrate, iso-butyl acetate, ethyl œnanthate, vanillin, eugenol, bergamot, orange, petitgrain, methyl salicylate, octyl acetate, duodecyl acetate, glycerine.

Pear Base, No. 1351.

400	Amyl acetate.
400	Ethyl „
70	„ butyrate.
70	Sweet orange oil.
30	Bergamot oil.
5	Eugenol.
20	Vanillin.
5	Methyl salicylate.
1000	

Pineapple Components.—Acetaldehyde, amyl acetate, butyrate and formate, benzyl formate and propionate, chloroform, ethyl acetate, butyrate, formate, and propionate, ethyl œnanthate, methyl cinnamate, phenylethyl valerianate, ethyl pelargonate and sebacate, vanillin, lemon, orange, petitgrain, pimento, camomile, glycerine, propyl valerianate, ethyl methyl phenylglycidate.

Pineapple Base, No. 1352.

500	Amyl butyrate.
200	Ethyl "
50	" acetate.
60	Acetaldehyde.
50	Chloroform.
20	Lemon oil.
10	Ethyl methyl phenylglycidate.
100	Propyl valerianate.
10	Vanillin.
1000	

Plum Components.—Acetaldehyde, amyl acetate and butyrate, benzaldehyde, ethyl acetate, formate, butyrate, œnanthate, methyl formate, undecalactone, gamma nonyl lactone, clove, pimento, coriander, lemon, mandarin, vanillin, glycerine.

Plum Base, No. 1353.

250	Acetaldehyde.
250	Ethyl acetate.
100	" butyrate.
50	" formate.
200	" œnanthate.
20	Benzaldehyde.
5	Gamma nonyl lactone.
10	Clove oil.
10	Mandarin oil.
5	Vanillin.
100	Glycerine.
1000	

Raspberry Components.—Amyl acetate, butyrate and formate, benzyl acetone, butyl formate, benzyl acetate, clove, cinnamon, ethyl acetate, benzoate, butyrate, caprylate, formate, sebacate, nitrite and œnanthate, iso-butyl acetate and formate, ionone, methyl salicylate, orris, mace, vanillin, heliotropin, benzoic, succinic and tartaric acids, glycerine, gamma nonyl lactone.

Raspberry Base, No. 1354.

300	Iso-butyl acetate.
200	Amyl ,,
100	Ethyl ,,
10	Clove oil.
50	Ethyl butyrate.
50	,, formate.
10	,, benzoate.
50	,, œnanthate.
30	,, nitrite.
70	Acetaldehyde.
10	Methyl salicylate.
20	Ionone alpha.
50	Succinic acid.
30	Gamma nonyl lactone.
20	Vanillin.
1000	

Strawberry Components.—Ethyl methyl phenylglycidate, amyl acetate and butyrate, benzyl acetone, ethyl acetate, butyrate, cinnamate, formate, nitrite, anthranilate, salicylate, pelargonate and œnanthate, geranyl butyrate, ionone, methyl salicylate, phenylethyl propionate, orris, geraniol, vanillin, coumarin, methyl naphthyl ketone, cinnamon, succinic acid, glycerine.

Strawberry Base, No. 1355.

100	Ethyl methyl phenylglycidate.
300	,, acetate.
30	,, benzoate.
200	,, butyrate.
100	,, nitrite.
50	,, pelargonate.
100	,, formate.
40	Amyl acetate.
30	Benzyl acetone.
10	Methyl naphthyl ketone.
20	,, salicylate.
10	Cinnamon oil.
10	Coumarin.
1000	

APPENDIX

CONVERSION TABLES.

1. Measures of weight—grams into avoirdupois
2. Grams per kilo into grains per pound.
3. Grams per litre into grains, etc., per fluid ounce, pint, and gallon.
4. C.c. per litre into minims, etc., per fluid ounce, pint, and gallon.
5. Measures of capacity—c.c. into pints.
6. Conversion data.
7. Fineness of powders.

Measures of Weight.

1 gram = the weight of 1 cubic centimetre (c.c. or mill.) of water at 4° C.
1 grain = 0·0648 gram.
1 oz. (Troy) = 31·1035 grams.
1 lb. avoirdupois = 453·593 grams.

	Gram.	Grains.	Avoirdupois.		
Milligram	0·001	·0154			
Centigram	0·01	·1543			
Decigram	0·1	1·5432			
Gram	1·0	15·4323	lb.	oz.	drams
Decagram	10·0	154·3234	0	0	5·65
Hectogram	100·0	1543·2348	0	3	8·5
Kilogram	1000·0	15432·3488	2	3	5

Grams per Kilo (parts per 1000).

Into Grains, etc., per Pound (7000 *grains*).

Grams per Kilo.	Per Pound.	
	Oz.	Grains (avoir.).
1	0	7·0
2	0	14·0
3	0	21·0
4	0	28·0
5	0	35·0
6	0	42·0
7	0	49·0
8	0	56·0
9	0	63·0
10	0	70·0
20	0	140·0
30	0	210·0
40	0	280·0
50	0	350·0
60	0	420·0
70	1	52·5
80	1	122·5
90	1	192·5
100	1	262·5
200	3	87·5
300	4	350·0
400	6	175·0
500	8	—
600	9	262·5
700	11	87·5
800	12	350·0
900	14	175·0
1000	16	—

APPENDIX

Grams per Litre.

Into Grains, etc., per Fluid Ounce, Pint, and Gallon.

Grams per Litre.	Grains per Fluid Oz.	Grains, etc., per Pint.		Grains, etc., per Gallon.			Grams per Litre.
		Oz.	Grains.	Lb.	Oz.	Grains.	
1	0·43	0	8·75	0	0	70·0	1
2	0·87	0	17·50	0	0	140·0	2
3	1·31	0	26·25	0	0	210·0	3
4	1·75	0	35·00	0	0	280·0	4
5	2·18	0	43·75	0	0	350·0	5
6	2·62	0	52·50	0	0	420·0	6
7	3·06	0	61·25	0	1	52·5	7
8	3·50	0	70·00	0	1	122·5	8
9	3·93	0	78·75	0	1	192·5	9
10	4·37	0	87·50	0	1	262·5	10
20	8·75	0	175·00	0	3	87·5	20
30	13·12	0	262·50	0	4	350·0	30
40	17·50	0	350·00	0	6	175·0	40
50	21·87	1	0	0	8	0	50
60	26·25	1	87·50	0	9	262·5	60
70	30·62	1	175·00	0	11	87·5	70
80	35·00	1	262·50	0	12	350·0	80
90	39·37	1	350·00	0	14	175·0	90
100	43·75	2	0	1	0	0	100
200	87·50	4	0	2	0	0	200
300	131·25	6	0	3	0	0	300
400	175·00	8	0	4	0	0	400
500	218·75	10	0	5	0	0	500
600	262·50	12	0	6	0	0	600
700	306·25	14	0	7	0	0	700
800	350·00	16	0	8	0	0	800
900	393·75	18	0	9	0	0	900
1000	437·50	20	0	10	0	0	1000

C.c. per Litre.

Into Minims, etc., per Fluid Ounce, Pint, and Gallon.

C.c. per Litre.	Per Fluid Oz.	Per Pint.		Per Gallon.			C.c. per Litre.
	Minims.	Fluid Oz.	Minims.	Pints.	Fluid Oz.	Minims.	
1	0·48	0	9·6	0	0	76·8	1
2	0·96	0	19·2	0	0	153·6	2
3	1·44	0	28·8	0	0	230·4	3
4	1·92	0	38·4	0	0	307·2	4
5	2·40	0	48·0	0	0	384·0	5
6	2·88	0	57·6	0	0	460·8	6
7	3·36	0	67·2	0	1	57·6	7
8	3·84	0	76·8	0	1	134·4	8
9	4·32	0	86·4	0	1	211·6	9
10	4·80	0	96·0	0	1	288·0	10
20	9·60	0	192·0	0	3	96·0	20
30	14·40	0	288·0	0	4	384·0	30
40	19·20	0	384·0	0	6	192·0	40
50	24·00	1	0	0	8	0	50
60	28·80	1	96·0	0	9	288·0	60
70	33·60	1	192·0	0	11	96·0	70
80	38·40	1	288·0	0	12	384·0	80
90	43·20	1	384·0	0	14	192·0	90
100	48·00	2	0	0	16	0	100
200	96·00	4	0	1	12	0	200
300	144·00	6	0	2	8	0	300
400	192·00	8	0	3	4	0	400
500	240·00	10	0	4	0	0	500
600	288·00	12	0	4	16	0	600
700	336·00	14	0	5	12	0	700
800	384·00	16	0	6	8	0	800
900	432·00	18	0	7	4	0	900
1000	480·00	20	0	8	0	0	1000

APPENDIX

Measures of Capacity.

1 litre = 1 cubic decimetre 35·214 fluid ounces.
1 gallon = 4·54596 litres.

	Litres.	Pints.
Millilitre (c.c. or mil.) .	0·001	0·0017
Centilitre . . .	0·01	0·0176
Decilitre . . .	0·1	0·1760
Litre	1·0	1·7607
Decalitre . . .	10·0	17·6077
Hectolitre . . .	100·0	176·0773
Kilolitre . . .	1000·0	1760·7734

Conversion Data.

Grams × 15·432 = grains.
Grains × 0·0648 = grams.
Ounces × 28·349 = grams.
Pints × 567·936 = cubic centimetres.
Gallons × 4·548 = litres.
Litres × 0·22 = gallons.

$$\frac{\text{Grains per gallon}}{0{\cdot}7} = \text{parts per } 100{,}000.$$

Parts per 100,000 × 0·7 = grains per gallon.

$$\text{Degrees Twaddell} = \frac{1000\ (\text{Specific Gravity}) - 1000}{5}.$$

$$\text{Specific Gravity} \quad \frac{(\text{Degrees Twaddell} \times 5) + 1000}{1000}.$$

Fineness of Powders.

Diameter of Particles Passing through a

No. 40 mesh sieve is less than 0·38 millimetre.
" 50 " " 0·28 "
" 60 " " 0·23 "
" 80 " " 0·17 "
" 100 " " 0·14 "
" 120 " " 0·12 "
" 150 " " 0·09 "
" 200 " " 0·07 "

TABLE I.

Specific Gravity of Mixtures of Alcohol and Water.

Specific Gravit at 60° F. (15·5° C.	Absolute Alcohol. By Volume.	Absolute Alcohol. By Weigh	Percentage of Proof Spirit.	Specific Gravity at 60° F. (15·5° C.).	Absolute Alcohol By Volume.	Absolute Alcohol By Weight.	Percentage of Proof Spirit.
1000	0·00	0·00	0·00	965	30·34	24·97	53·04
999	0·66	0·53	1·16	964	31·18	25·68	54·51
998	1·34	1·0	2·33	963	31·99	26·37	55·93
997	2·02	1·61	3·52	962	32·79	27·06	57·33
996	2·72	2·1	4·73	961	33·56	27·73	58·68
995	3·42	2·73	5·98	960	34·33	28·39	60·03
994	4·14	3·31	7·24	959	35·06	29·03	61·32
993	4·[illegible]	3·90	8·51	958	35·79	29·66	62·60
992	5·63	4·51	9·82	957	36·50	30·28	63·85
991	6·40	5·13	11·16	956	37·20	30·90	65·09
990	7·18	5·76	12·53	955	37·89	31·50	66·29
989	7·98	6·41	13·94	954	38·57	32·09	67·48
988	8·80	7·08	15·38	953	39·22	32·67	68·62
987	9·65	7·76	16·85	952	39·87	33·25	69·76
986	10·51	8·46	18·34	951	40·50	33·81	70·87
985	11·40	9·18	19·87	950	41·13	34·37	71·98
984	12·29	9·91	21·44	949	41·74	34·92	73·05
983	13·20	10·65	23·02	948	42·35	35·46	74·12
982	14·13	11·42	24·66	947	42·95	36·00	75·17
981	15·08	12·20	26·32	946	43·54	36·54	76·21
980	16·04	12·99	27·99	945	44·13	37·07	77·24
979	17·02	13·80	29·70	944	44·71	37·60	78·26
978	18·00	14·61	31·42	943	45·28	38·12	79·26
977	18·99	15·43	33·15	942	45·85	38·64	80·26
976	19·98	16·25	34·87	941	46·40	39·15	81·23
975	20·97	17·08	36·61	940	46·95	39·65	82·19
974	21·96	17·90	38·35	939	47,50	40·15	83·15
973	22·94	18·72	40·06	938	48·04	40·65	84·10
972	23·91	19·53	41·77	937	48·57	41·15	85·04
971	24·85	20·34	43·47	936	49·10	41·64	85·97
970	25·83	21·14	45·14	935	49·63	42·13	86·89
969	26·77	21·93	46·77	934	50·15	42·62	87·81
968	27·69	22·71	48·38	933	50·67	43·11	88·71
967	28·69	23·48	49·98	932	51·18	43·59	89·61
966	29·48	24·23	51·53	931	51·68	44·06	90·49

TABLE I.—*continued.*

Specific Gravity of Mixtures of Alcohol and Water.

Specific Gravity at 60° F. (15·5° C.).	Absolute Alcohol.		Percentage of Proof Spirit.	Specific Gravity at 60° F. (15·5° C.).	Absolute Alcohol.		Percentage of Proof Spirit.
	By Volume.	By Weight.			By Volume.	By Weight.	
930	52·18	44·53	91·36	897	67·08	59·37	117·54
929	52·67	45·00	92·93	896	67·50	59·80	118·26
928	53·16	45·47	93·09	895	67·92	60·23	118·98
927	53·65	45·94	93·95	894	68·33	60·66	119·70
926	54·14	46·40	94·80	893	68·74	61·09	120·42
925	54·62	46·87	95·65	892	69·14	61·52	121·14
924	55·10	47·33	96·49	891	69·55	61·95	121·85
923	55·58	47·79	97·33	890	69·95	62·38	122·56
922	56·05	48·25	98·16	889	70·35	62·81	123·27
921	56·52	48·71	98·98	888	70·75	63·24	123·97
920	56·99	49·17	99·80	887	71·15	63·67	124·06
91976	57·10	49·28	100·00	886	71·55	64·10	125·37
				885	71·95	64·53	126·07
919	57·46	49·63	100·62	884	72·34	64·96	126·77
918	57·92	50·08	101·43	883	72·24	65·39	127·46
917	58·38	50·53	102·24	882	73·13	65·81	128·14
916	58·83	50·98	103·05	881	73·52	66·24	128·82
915	59·29	51·43	103·84	880	73·91	66·66	129·50
914	59·74	51·88	104·63	879	74·30	67·09	130·18
913	60·19	52·33	105·42	878	74·68	67·51	130·86
912	60·63	52·77	106·20	877	75·06	67·93	131·53
911	61·07	53·21	106·97	876	75·44	68·35	132·19
910	61·51	53·65	107·74	875	75·82	68·77	132·86
909	61·95	54·10	108·52	874	76·19	69·19	133·53
908	62·39	54·54	109·29	873	76·57	69·62	134·19
907	62·83	54·98	110·06	872	76·94	70·04	134·84
906	63·26	55·42	110·82	871	77·32	70·46	135·50
905	63·70	55·87	111·59	870	77·69	70·88	136·16
904	64·13	56·31	112·35	869	78·06	71·30	136·81
903	64·56	56·75	113·10	868	78·43	71·72	137·46
902	64·98	57·18	113·84	867	78·80	72·14	138·10
901	65·41	57·62	114·59	866	79·17	72·55	138·74
900	65·83	58·06	115·33	865	79·53	72·97	139·38
899	66·25	58·50	116·07	864	79·89	73·39	140·02
898	66·67	58·93	116·81	863	80·25	73·81	140·65

TABLE I.—*continued.*

Specific Gravity of Mixtures of Alcohol and Water.

Specific Gravity at 60° F. (15·5° C.).	Absolute Alcohol.		Percentage of Proof Spirit.	Specific Gravity at 60° F. (15·5° C.).	Absolute Alcohol.		Percentage of Proof Spirit.
	By Volume.	By Weight.			By Volume.	By Weight.	
862	80·61	74·22	141·28	827	91·98	88·27	161·26
861	80·97	74·64	141·91	826	92·26	88·65	161·76
860	81·32	75·05	142·54	825	92·55	89·03	162·26
859	81·68	75·47	143·16	824	92·83	89·41	162·75
858	82·03	75·88	143·78	823	93·11	89·79	162·24
857	83·38	76·30	144·40	822	93·38	90·16	163·72
856	83·73	76·71	145·01	821	93·65	90·53	164·20
855	83·08	77·12	145·62	820	93·92	99·90	164·67
854	83·42	77·53	146·23	819	94·19	91·27	165·14
853	83·77	77·94	146·83	818	94·45	91·63	165·60
852	84·11	78·35	147·43	817	94·71	92·00	166·06
851	84·44	78·76	148·03	816	94·97	92·36	166·51
850	84·78	79·17	148·62	815	95·22	92·72	166·96
849	85·12	79·58	149·21	814	95·47	93·08	167·41
848	85·46	79·98	149·80	813	95·72	93·44	167·86
847	85·80	80·39	150·39	812	95·97	93·80	168·28
846	86·12	80·79	150·97	811	96·21	94·15	168·71
845	86·44	81·20	151·55	810	96·45	94·50	169·13
844	86·77	81·60	152·12	809	96·69	94·85	169·55
843	87·09	82·00	152·68	808	96·93	95·20	169·96
842	87·42	82·40	153·25	807	97·16	95·55	170·37
841	87·74	82·80	153·81	806	97·39	95·89	170·77
840	88·06	83·20	154·37	805	97·62	96·23	171·17
839	88·37	83·60	154·92	804	97·84	96·57	171·56
838	88·68	83·99	155·47	803	98·06	96·91	171·95
837	88·99	84·39	156·02	802	98·28	97·25	172·23
836	89·30	84·78	156·56	801	98·49	97·59	172·71
835	89·61	85·17	157·10	800	98·70	97·91	173·07
834	89·91	85·56	157·63	799	98·91	98·24	173·44
833	90·22	85·95	158·16	798	99·12	98·57	173·80
832	90·52	86·34	158·68	797	99·32	98·90	174·16
831	90·82	86·73	159·21	796	99·52	99·22	174·52
830	91·11	87·11	159·73	795	99·72	99·55	174·87
829	91·40	87·50	160·24	794	99·92	99·87	175·21
828	91·69	87·88	160·75	79359	100·00	100·00	175·35

TABLE II.

Dilution of Alcohol by Volume with Distilled Water.

Percentage Strength of Alcohol required by Volume.	Add to 1000 of Alcohol at								
	90.	85.	80.	75.	70.	65.	60.	55.	50.
	Per Cent by Volume.								
85	66								
80	138	69							
75	219	145	72						
70	311	231	153	77					
65	414	330	247	164	82				
60	537	445	354	265	176	88			
55	679	579	481	383	286	190	95		
50	847	739	630	524	417	313	205	104	
45	1053	933	814	695	578	461	345	229	114
40	1308	1173	1040	908	776	645	514	385	256
35	1633	1480	1329	1178	1029	880	700	583	436
30	2062	1886	1711	1535	1363	1189	1017	845	675
25	2661	2452	2243	2036	1828	1622	1417	1212	1007
20	3558	3298	3040	2783	2526	2270	2014	1760	1506
15	5053	4710	4369	4028	3689	3349	3011	2673	2336
10	8045	7537	7029	6522	6016	5511	5005	4502	2999

Examples: To convert 90 per cent to 45 per cent add to 1 litre
1053 c.c. Aqua Destil.
To convert 75 per cent to 20 per cent add to 1 litre
2783 c.c. Aqua Destil.

TABLE III.

Dilution of Alcohol by Weight with Distilled Water.

Percentage Strength of Alcohol Used.	To Produce 1000 of Alcohol at 50.	60.	70.	80.	90.
	Per Cent by Weight.				
96	453	555	665	783	913
95	460	564	676	796	927
94	467	573	686	808	942
93	474	582	697	820	956
92	481	590	707	832	970
91	489	599	718	845	985
90	496	609	728	858	
89	504	618	740	871	
88	511	627	752	884	
87	519	637	763	898	
86	527	646	774	912	
85	535	656	786	926	
84	543	667	798	940	
83	552	677	811	955	
82	560	687	823	969	
81	569	698	836	984	
80	578	709	849		
79	587	720	863		
78	597	732	877		
77	606	744	891		
76	616	756	905		
75	626	768	920		
74	636	781	935		
73	647	794	951		
72	658	807	967		
71	669	821	983		
70	681	835			
69	692	849			
68	705	864			
67	717	880			
66	730	896			
65	743	911			
64	756	928			
63	770	946			
62	785	963			
61	800	981			
60	815				
59	831				
58	847				
57	864				
56	881				
55	901				
54	918				
53	938				
52	958				

Examples: To make a kilo of 90 per cent by weight take

(1) 913 grams of 96 per cent alcohol and add distilled water to make 1000 grams, or

(2) 956 grams of 93 per cent.

Alcohol Table (to required weight and volume).

Showing the Strength of Alcohol (Percentage Absolute) with its Specific Gravity, also the Weight or Volume Required to make one Kilogram or one Litre of another Strength by the Addition of Distilled Water at 15·5° Centigrade or 60° Fahrenheit.

Strength of Absolute Alcohol.	Specific Gravity by		Quantity of Alcohol of Known Strength Required to Make 1000.									
			50 per Cen by		60 per Cent by		70 per Cent by		80 per Cent by		90 per Cent by	
	Weight.	Volume	Weight. Grams.	Volume. C.c.	Weight. Grams.	Volume C.c.	Weight. Grams.	Volume. C.c.	Weight. Grams.	Volume. C.c.	Weight. Grams.	Volume. C.c.
96 per cent	0·8065	0·8125	453	520	555	625	665	730	783	833	913	935
93 ,,	0·8149	0·8237	474	537	582	645	697	752	820	860	956	967
90 ,,	0·8229	0·8339	496	555	609	666	728	777	858	888		
85 ,,	0·8359	0·8496	535	588	656	705	786	823	926	941		
80 ,,	0·8484	0·8639	578	602	709	750	849	875				
75 ,,	0·8605	0·8773	626	666	768	800	920	933				
70 ,,	0·8724	0·8900	681	701	835	852						
65 ,,	0·8842	0·9021	743	769	911	923						
60 ,,	0·8958	0·9134	815	833								
55 ,,	0·9072	0·9242	901	981								

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