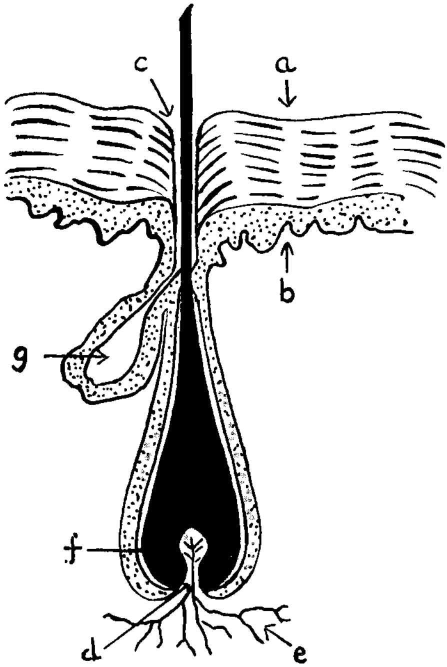


FIG. 1.—DIAGRAM OF HAIR ROOT AND FOLLICLE.

(*a*) Outer horny layer of epidermis ; (*b*) Inner, or Malpighian, layer of epidermis ; (*c*) Mouth of follicle ; (*d*) Papilla ; (*e*) Capillaries ; (*f*) Hair bulb ; (*g*) Sebaceous gland.

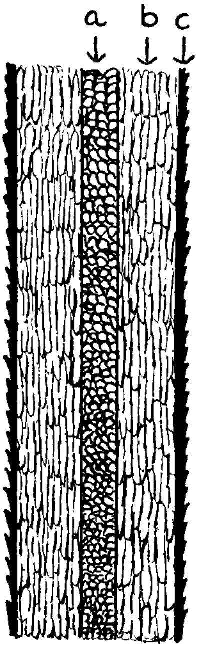


FIG. 2.—DIAGRAM OF HAIR SHAFT.

(*a*) Medulla ; (*b*) Cortex ; (*c*) Cuticle.

Frontispiece.

HAIR-DYES AND HAIR-DYEING CHEMISTRY AND TECHNIQUE

Being a Second Edition of
" BLONDE OR BRUNETTE ? "

By

H. STANLEY REDGROVE
B.Sc., F.I.C., F.R.H.S.
Author of " Scent and All About It,"
" The Cream of Beauty," etc.

and

GILBERT A. FOAN
Secretary of the Hairdressers' Parliamentary
Committee Ltd., and Parliamentary Secretary to
the Hairdressers' Registration Council

With Eight Plates and numerous
Illustrations in the Text

LONDON
WILLIAM HEINEMANN
(MEDICAL BOOKS) LTD.
1934

Printed in Great Britain.

While some bring leaves of henna, to imbue
The fingers' ends with a bright roseate hue,
So bright, that in the mirror's depth they seem
Like tips of coral branches in the stream ;
And others mix the Kohol's jetty dye
To give that long, dark languish to the eye
Which makes the maids, whom kings are proud to cull
From fair Circassia's vales, so beautiful !

THOMAS MOORE.

PREFACE

HAIR-DYEING is a legitimate and useful art. If this book should come into the hands of any who think otherwise, we refer them to the section headed " The Ethics and Æsthetics of Hair-Dyeing." Like all arts, it has a scientific basis ; but, unfortunately, this has not, speaking generally, received the attention from chemists that it deserves. Indeed, one might well call Hair-dyeing the Cinderella of applied chemistry.

There is little literature on Hair-dyeing, and what does exist, apart from a very few books and articles, is of a rather unsatisfactory character, being in some cases positively misleading.

In the making of this book, a chemist and a practical hairdresser have collaborated, and we believe that we have produced the most complete treatise on the subject which has been written in any language, and one, moreover, which will fill a very real need.

We offer it to the general reader, to the hairdresser and beauty-culturist, and to the chemist. To the first two we say : Forgive us for some scientific technicalities, which we have indeed tried to make as simple as possible. To the last we say : Think of the first two and forgive us for much of what is, to you, uninteresting, elementary stuff.

The general reader, we think, may be interested to be initiated into the mysteries of a little-known art. He (or she) may even be interested because of some slight defect in the colouring of his (or her) own hair . . . a slight greyness, it may be. The chemist, we hope, will be stimulated to undertake much-needed research in what is a very useful and interesting branch of applied chemistry. And, finally, to the hairdresser let us say : It is up to you, not only to master the technique of this art, but also thoroughly to understand the scientific principles underlying it. By this means, and by this means alone, will you be able to give your clients complete satisfaction. And by this means will you reap, not only the pleasure which comes from increased and profitable business, but also that of knowing that you are helping to increase the amount of Beauty in the world.

We desire to acknowledge our indebtedness to the Director of the Royal Botanic Gardens, Kew ; Messrs. Broux & Sons, of Paris ; M. E. Long, of Paris ; Messrs. the Camomile Tonic Co., of London ; Messrs. l'Oréal, of Paris, and their British agents, Messrs. Debacq and Harrop, of London ; Messrs. the Evan Williams Co., Ltd., of London ; and Messrs. Stafford Allen & Sons, Ltd., of London and Long Melford, for valuable and useful information supplied, and, in the cases of the last three firms, for permission to use illustrations appearing in their booklets ; to Miss V. A. Venables for making several of the sketches with which this book is illustrated ; and to the Editor of the *Hairdressers' Chronicle and Beauty Specialists' Trade Journal* for permission to reproduce matter and illustrations which have appeared in his journal.

H. S. R.
G. A. F.

CROYDON,
March, 1929.

LIST OF ILLUSTRATIONS

BLONDE OR BRUNETTE ?

PART I

PRELIMINARY CONSIDERATIONS CONCERNING THE STRUCTURE AND PIGMENTS OF THE HAIR AND COLOURING MATTERS GENERALLY

BEFORE the art of hair-dyeing can be mastered, the construction of the hair must be thoroughly understood. We commence, therefore, with a short account of this subject.*

In colloquial language the beard is sometimes referred to as " face fungus " or " chin moss," and there is an idea prevalent that hair has an independent life of its own and grows on the body like mosses and fungi grow on trees. This idea, however, is quite erroneous. Hair is an outgrowth of the skin and must be regarded as a modification of the epidermis. In this sense, it resembles the nails of the human fingers and toes, the feathers of birds, the hoofs of horses and cattle, the quills of the porcupine, etc.

THE HAIR-ROOT

In hair-dyeing and bleaching we are concerned with the portion of the hair which projects beyond the scalp (or other part of the body) and which offends our artistic sensibilities by losing its colour and becoming grey. This portion may be called the " shaft," although it should be understood that it is in no sense a separate structure from the part concealed below the normal surface, and which is popularly, but inaccurately, called the " root."

In the first place, it should be understood that, correctly

---

* Very complete accounts of the histology of hair will be found in Koelliker's *Manual of Human Histology* (translated by Huxley and Busk, London, 1853–54), vol. 1, pp. 168–203 ; Quain's *Elements of Anatomy* (tenth edition, edited by Schafer and Thane, London, 1891), vol. 1, pp. 420–427 ; and Schafer's *The Essentials of Histology* (eleventh edition, London, 1920), pp. 274–282.

speaking, the hair does not pierce the skin. Each hair is enclosed in a pocket or sac, formed by an indentation of the skin, as shown in Fig. 1, and known as a " follicle." Occasionally two or more hairs may share one and the same pocket. The follicles extend through the entire thickness of the skin and rest upon the fat underlying this. In the case of the hairs of the human scalp, the average depth of the follicle is about one-tenth of an inch.

At the extreme end of the follicle is situated a small body, shaped like a button-mushroom, which projects into it. This is called the " papilla." The base of each hair is swollen into an inverted cup or " hair-bulb," which fits over this projection.

The papillæ are most active and important little organs. Containing a network of blood-vessels and nerves, by means of which they are nourished and energised, they are responsible for the formation and growth of the hair, their function being the production of the various types of cells of which hair consists.

These cells are continually added at the base of each hair, which is thereby caused to project further beyond the surface of the scalp or other part of the body. When the connection between the hair-bulb and the papilla is broken, the hair falls out. It may be pushed out by a new hair. This latter process occurs normally in a healthy head, old hairs being continually replaced by new ones. According to various estimates which have been made, the life period of a normal scalp hair varies from a few months up to four years or more.*

Another function of the papillæ is the production of the pigments to which the colour of the hair is due, and which will be considered in detail later.

The papilla may justly be considered as one of Nature's most wonderful manufactories. It is this organ alone which should correctly be called the " hair-root," although, later in this book, when the practical technique of hair-dyeing is dealt with, we employ the word " roots," for want of a more suitable term, to designate the portion of the hair situated *immediately* above the scalp.

---

* Pincus's estimate is two to six years. See J. Pincus : *The Hair : Its Treatment in Health, Weakness and Disease* (London, 1882), p. 11.

THE SEBACEOUS GLANDS

The hair follicle is bottle-shaped, the neck of the bottle narrowing upwards towards the surface of the scalp. Just below the mouth of the follicle and connected to it by a narrow tube or duct is situated a sebaceous gland, as shown in Fig. 1. There may be two sebaceous glands connected to a follicle, or, sometimes even more. These glands manufacture a greasy or waxy substance somewhat resembling tallow, hence its name " sebum " (the Latin word for " tallow ") and that of the glands which secrete it.

Sebum is Nature's lubricant for the hair, designed to keep it in a healthy and elastic condition. The exact chemical constitution of this material is not definitely known ; but it would appear to consist largely of cholesterol and closely allied substances, partly in a free state, but mainly in combination with various fatty acids. That is to say, sebum is very similar in composition to lanoline, toilet lanoline, which is purified wool-wax intimately mixed with water, containing a large proportion of this substance, cholesterol, a substance classed by chemists as an " alcohol."

Perhaps the most common disease of the scalp is that known as " seborrhea," which is a morbid condition characterised by excessive oiliness, due to over-secretion of sebum. In acute cases, the narrow neck and mouth of the follicle may become blocked up with sebum, which, being unable to escape, exerts a backward pressure on the papilla, resulting in its atrophy and causing the hair to fall out.

The character of the sebum has to be taken into account in approaching the problem of dyeing the hair ; and it will readily be appreciated that when such a condition as seborrhea exists, this renders the problem more difficult of solution and adversely affects the results obtained.

THE HAIR-SHAFT

The hair-shaft, or, rather, the hair itself, normally consists of three distinct portions or layers, as shown in Fig. 2, which are distinguished by the names " medulla " (innermost layer, or pith), " cortex " (inner layer), and " cuticle " (outer layer). It is necessary to give a somewhat detailed description of these.

In the first place, it should be made perfectly plain that the common supposition that hairs are hollow is totally erroneous. Hairs are much more like rods than tubes. The innermost part of a hair, or MEDULLA, is best likened to pith. It is composed of one, two, or sometimes more series of tiny cells, roughly oval, but angular in shape, and often containing granules of pigment. Sometimes cells are present inflated with air, more frequently air occurs intercellularly. In the case of languo or badly-developed hairs, the medulla may be absent; but it is always present in those hairs which are well developed and strong.

From the point of view of dyeing, this portion of the hair is relatively unimportant, as it is most unlikely that any dye employed ever reaches it.

The CORTEX, situated between the medulla and the cuticle, is the most important layer, occupying the main bulk of the shaft. It is composed of numerous series of long, spindle-shaped cells, closely packed together, and forming a fibrous mass. Air bubbles and pigment are also present, the pigment occurring in two forms: in granules in the case of dark coloured hair; in a diffused form in light red hair; or in both forms in intermediate shades.

The nature of the cortex largely determines the shape, texture and strength of the hair. It is responsible for hair being straight, wavy or curly, as the case may be. The cortex of straight hair, and hence the hair itself, is circular in section. In wavy and, especially, curly hair, owing to some deformation or irregularity in development of the cells, the section is more or less elliptical or flattened.

The CUTICLE is made up of a single layer of pointed scales which closely overlap each other like those of a fish, the apex of each scale pointing in a direction away from the root. These scales vary considerably in different types of hair, both in form and size. The imbricated structure of the cuticle and the variations exhibited by its constituent scales are of great importance in hair-dyeing, and will be considered in greater detail in this connection in a later section.

THE CHEMICAL COMPOSITION OF HAIR

The fact that hair must be regarded, in common with nails, hoofs, feathers, etc., as a modified epidermis, has already been pointed out. These all consist essentially of a substance called " keratin." Perhaps it would be more correct to say, " a group of substances collectively called keratin " ; for, whilst the keratin of hair is closely allied to that obtained from other sources, it is probably not identical therewith.

Keratin is classed as an albuminoid. Compared with other members of this group of substances, it is particularly rich in sulphur, some samples of red hair containing as much as 8 per cent.

Part of the sulphur contained in keratin is very loosely combined, and can be removed by the action of alkalies, or, indeed, to a certain extent, by boiling with water. The presence of this loosely combined sulphur is made use of in many hair-dyes, in which the active ingredient is a compound of a metal capable of combining with the sulphur to form a suitably coloured pigment, a matter fully dealt with in Part II.

In general, however, keratin must be described as most resistant to chemical reaction, and it is insoluble in all ordinary solvents. It is attacked, however, by concentrated nitric acid, with the formation of a yellow-coloured substance, and is dissolved by hot caustic alkalies. Alkaline sulphides and sulphides of alkaline earth metals also attack it, and form the basis of the majority of depilatories. It will be readily appreciated that satisfactorily to colour a hard, resistant material of this character constitutes a most difficult task.

The chemical constitution of keratin is unknown ; probably it is not a definite chemical individual. Several analyses of the ultimate composition of human hair have been published. These do not always agree very well with each other, the disagreement being partly explained by the fact that hair is somewhat variable in composition. The following must be taken as approximate figures only :—

Carbon	50 to 54 per cent.
Hydrogen	6·3 per cent.
Nitrogen	17 to 18 per cent.
Sulphur	5 ,, 8 ,,

The balance consists largely of oxygen. Small and variable quantities of other elements, however, are also present. When hair is burned, from ¼ to 2 per cent. of ash is obtained, and the following additional elements have been identified in this: sodium, potassium, calcium, magnesium, phosphorus, silicon, chlorine and iron.

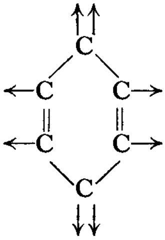
According to Hogounenq, white hair gives most ash, whilst pigmented hair contains more iron.

THE CAUSE OF COLOUR

Before proceeding to a discussion of the pigmentation of the hair, a few words may be desirable on the general question of the chemistry of colour, one of outstanding importance to the art of hair-dyeing.

During the last few decades, chemists have devoted a great deal of attention to the problem of the cause of colour, the complete elucidation of which is so vital to the development of the aniline dye industry.

The colour of substances is undoubtedly connected with certain peculiarities in their chemical composition, being due, in many cases, to the presence in their molecules or smallest parts of certain *groupings* of atoms. We have emphasised the word "groupings," because so often it would seem to be this which is of importance. In particular, as concerns organic substances, or substances containing the element carbon, a peculiar grouping of carbon atoms and attractive forces, designated "quinonoid" by chemists, is often found present in the molecules of coloured substances. This particular grouping is shown in the diagram below, in which the C's represent carbon atoms and the lines attractive forces, those with arrow-heads holding other atoms in combination :—



The chromogenetic groupings are frequently of an unstable character, and it is quite possible that it is this very instability which is the cause of the colour. This helps to explain why difficulty is experienced in producing really "fast" dyes. However, the exact relationship between colour and chemical composition is unknown, and the whole question bristles with difficulties, involving theoretical considerations of a highly abstruse nature, into which we cannot enter.

THE COLOUR OF THE HAIR

So far as the colours occurring in living organisms are concerned, some, such as the blue of the wings of many birds and dragon-flies, are purely optical effects. Others are caused by pigments of complex chemical constitution containing the element carbon. In some cases the exact chemical structure is known ; and, in many instances, this is of the quinonoid type referred to in the preceding section. Some examples will be met with in Part II., amongst the colouring matters extracted from plants and used for dyeing the hair.

In the case of hair itself, the extraction of the colouring matter, which is insoluble in all ordinary solvents, such as water, alcohol, ether, dilute acids, etc., is so extraordinarily difficult that its nature remains largely wrapped in mystery.

There is evidence for believing, however, that there are two (or, at least two) distinct pigments, which, present in various proportions and accompanied by few or many air-bubbles, are responsible for the many colours and shades exhibited by hair. One pigment is reddish yellow and occurs in a diffuse form ; the other is sepia-brown and is present in minute granules. Only the first pigment occurs in red hair, a variety of shades being produced according to the amount present. The second pigment, on the other hand, is responsible for the colour in black and dark hair, lighter shades being the result of a paucity of the granules, or, in the case of golden and reddish tones, to the presence of the first pigment as well.

It is tolerably certain that these pigments are of highly complex structure chemically. That they are closely connected with the pigments (melanin) of the skin is probable.

That they are related in constitution to hæmoglobin or red colouring matter of the blood, and chlorophyll or green colouring matter of plants, is an interesting conjecture. But, in spite of many assertions * which have sometimes been made in a most assured manner, the composition of these bodies remains unknown.

Spiegler has denied the presence of iron in the colouring matter of the hair, a statement hard to reconcile with Hogounenq's conclusion that pigmented contains more iron than non-pigmented hair, and probably based on insufficient grounds. The more commonly held view is that iron, in some way or another, is responsible for the colour of dark hair. That red hair contains more sulphur than hair of another hue seems to be well established. In any case, however, it may be taken as certain that if either of these elements are present in a particular pigment, it is not merely their presence, but also and especially their mode of combination, which is responsible for the colour of the pigment in question.

The macrocosmic colour of the hair is due, not only to the effect of the pigments, but also to that of the air-bubbles, present in the medulla and cortex. These bubbles reflect light. In consequence, whilst by reflected light they look like bright white spots, by transmitted light they appear to be black. These effects in combination with the colours of the pigments produce a multitude of different shades and tones. If a superabundance of air-bubbles are present, the light is unable to reach the pigment, and the hair appears to be grey.

The question of the atrophy of the pigments and the increase in the number of air-bubbles in relation to canities, or greyness of the hair, as well as that of other suggested causes for this phenomenon, is dealt with in Part IV., where we endeavour to give some practical advice concerning this matter.

THE PROBLEM OF HAIR-DYEING IN RELATION TO STRUCTURE

The problem of dyeing the hair, difficult as it is of satisfactory solution, would be far more difficult but for the imbri-

---

* In *Blue Book Recipes on Scientific Hair-Colouring*, for example, it is stated that the pigments are soluble in alcohol, ether, etc., and their chemical formulæ are given !

cated structure of the cuticle, which makes possible the penetration of the hair by a suitable liquid. Sometimes, as already mentioned, advantage is taken of the loosely-combined sulphur of the keratin in the formation of the pigment. In the case of one or two dyes a more deep-seated form of combination between the keratin and the active principle of the dye would appear to take place. Frequently, the pigment is deposited in an insoluble form by chemical interaction between the constituents of the dye, or between the dye and the oxygen of the air. In all cases it is very important that the reagents producing the pigment should pass between the overlapping scales of the cuticle into the cortex and deposit or form the pigment there. Otherwise the effect is apt to be transitory, the colour being removed by washing and the wear and tear to which hair is inevitably subjected. The probability is that, in many cases, penetration is not effected ; the cuticle alone is coloured, and the result is not satisfactory.

One factor which prevents penetration, or even coloration of the cuticle, is the sebum, with which normal hair is thinly coated. It is as impossible to dye hair in this condition as it would be to write with pen and ink on a piece of paper coated with wax. The first problem that confronts the art of hair-dyeing, therefore, is that of removing the sebum. This is effected by means of much the same substances as are employed to cleanse other objects from grease, namely, soap dissolved in water or alcohol, or solutions of alkalies. Soap and water emulsify grease, thus facilitating its removal ; alkalies saponify it, that is to say, react with it chemically to produce soap. The alkalies employed in the art of hair-dyeing comprise sodium hydroxide (caustic soda), potassium hydroxide (caustic potash), ammonia, sodium carbonate (washing soda), potassium carbonate and borax, of which the last exercises the mildest action. Sodium and potassium hydroxides, it may be added, are very caustic in action, as their common names imply. They are dangerous substances whose use is to be deprecated.

Alkalies often enter into the composition of the dyes ; but, even so, it is usually necessary thoroughly to shampoo the hair before attempting to dye it, in order to remove the sebum and thus make penetration possible. In some cases, the hair is very greasy, even to an objectionable extent, owing to over-secretion of sebum. Abnormal hair of this type is very difficult to dye, and special treatment may be necessary. The whole question is fully discussed from a practical point of view in the chapters devoted to the Technique of Shampooing in Part III.

Variations in the structure of the hair, to which reference has already been made, also play a part in determining the ease or otherwise with which hair can be dyed.

Experience shows the easiest form of hair to dye is that which is straight and of normal texture. Both very fine hair and very coarse hair are found, in practice, to offer more resistance to the action of dyes than that of normal texture. For example, the fine hair fringing the forehead and temples is usually less easy to dye than the rest of the hair on the head. The hairs of the moustache and beard also strongly resist the action of most dyes ; and shaving, which encourages the growth of short, strong hairs, seems to increase this power of resistance. The reason is obscure ; possibly these peculiarities are due to differences in the size and shape of the cuticle scales.

Both curly and wavy hair are also found, in practice, more difficult to dye than that which is straight. The very curliness of curly hair renders even distribution of the dye more difficult to obtain ; and, whilst this type of hair is more porous than straight hair, its porosity seems to be unevenly distributed. These peculiarities may be due to the irregularities in structure which produce the curls and waves, the cuticle scales in one place being tightly crowded together, forming an impenetrable barrier to the passage of a fluid, in another spread out so as to render penetration easy.

PART II

ABOUT HAIR-DYES, BLEACHES AND DECOLORANTS, THEIR NATURE, COMPOSITION, AND USES

CHAPTER I

INTRODUCTION

THE art of hair-dyeing is one of great antiquity. From the earliest times man has sought means wherewith to change the colour of his hair in accordance with his ideas of beauty and to hide the grey hairs of oncoming age. Some of the substances used by the ancients are still employed to-day. Others have passed into the limbo of forgotten superstitions.

According to the Book of Enoch, one of the arts taught mankind (or perhaps one should say womankind) by the angel Azazel before the Flood, was that of beautifying the eyebrows ; and it was with kohl, no doubt, that Jezebel " painted her eyes " when expecting Jehu at Jezreel.

Henna is another ancient dye, much valued to-day because of its harmless character and its beneficial effect on the texture of the hair. Its use as a cosmetic by the ladies of Eastern lands goes back to prehistoric times. In ancient Egypt, a woman would have thought it positively indecent to have appeared with finger nails which were not stained red with henna.

The custom of dyeing the finger nails, the palms of the hands and the soles of the feet with henna still persists in Egypt, and is practised by Mohammedan women in India and elsewhere, as well, to some extent, by Hindus. Apart from its action as a dye, it is possible that the henna tends to retard excessive perspiration and to exercise a beneficial cooling effect.

A tradition says that Mohammed described henna as " the best of herbs," and used it himself to dye his beard. Mohammedans, in consequence, attribute to it wonderful therapeutic properties, and employ it as a cure for numerous ills. Sir George Birdwood * writes, " It is used . . . as a medicine ; the roots made into a poultice for sore, war-worn feet, and as an application to ulcers, and the powdered leaves internally in leprosy ; but, so far as I have observed, with little efficacy." He adds, " Its most interesting use is in burning the seeds as an incense to ward off evil spirits."

Hair-dyeing and bleaching were much resorted to in the days of classical Rome. Golden hair was then held in great admiration by the ladies, probably because their tresses were usually raven black. Sometimes substances of a very deleterious nature were used to bleach the hair, such as quicklime, with disastrous results. In one of the works of Ovid, to whom we are so deeply indebted for our knowledge of the domestic life of the ancient Romans, there is a letter in which he upbraids his mistress for having destroyed her hair by a preparation of this character. He writes :—

> " I always used to say ; ' Do leave off doctoring your hair.' And now you have no hair left, that you can be dyeing. But, if you had let it alone, what was more plenteous than it ? It used to reach down your sides, so far as ever they extend. . . . Besides, it was quite tractable, and falling into a thousand ringlets ; and it was the cause of no trouble to you. . . .
>
> " These beauteous locks are gone : which Apollo might have longed for, and which Bacchus might have wished to be on his own head. . . . No enchanted herbs of a rival have done you this injury ; no treacherous hag has been washing you with Hæmonian water. The effects, too, of no disease have injured you ; (far away be all bad omens ;) nor has an envious tongue thinned your abundant locks ; 'twas your own self who gave the prepared poison to your head. Now Germany will be sending for you her captured locks ; by the favour of a conquered race you will be adorned. Ah ! how many a time will you have to blush, as any one admires your hair ; and then you will say, ' Now I am receiving praise for a bought commodity ! In place of myself, he is now bepraising some Sygambrian girl unknown to me ; still, I remember the time when that glory was my own.' " †

---

* *Journal of the Royal Society of Arts* (1917), vol. 65, p. 367.

† *The Amores*, Book I., Elegy XIV., Riley's translation.

Nowadays, although it cannot be claimed that any method is yet known of producing artificially an *exact* imitation of natural golden hair, no lady who, believing that " gentlemen prefer blondes " (even if they " marry brunettes "), desires to have her hair bleached, need fear the calamity that befell Ovid's mistress, provided the work is carried out by a properly qualified hairdresser, who follows the methods outlined in this book.

THE ETHICS AND ÆSTHETICS OF HAIR-DYEING

On one occasion, the Roman writer of epigrams, Martial, sent a blonde hair-dye, as an ironic jest, to a bald-headed octogenarian ; and it is remarkable how, throughout the ages, hair-dyes and humour appear as inseparable companions.

Is dyed hair funny ? And if so, why ? The answer to both questions is that dyed hair—when it proclaims its artificial origin—affects us with a sense of its incongruity. In his *Gulistan*, the Persian poet, Sa'di, writes the following very pertinent lines :—

> " A beldame stained her hoary tresses black :
> ' O little mother of old times,' I said,
> ' Most cunningly thou hast adorned thy head,
> Yet never canst thou stretch the crooked back.' "

Nothing, indeed, can be more incongruous than a raven-black or golden head of hair attached to a woman who in other respects proclaims her many years. And, as the philosopher, Bergson, has pointed out, the sense of humour has its roots in the perception of incongruity.

Some authorities have denounced hair-dyeing *in toto* on the ground of incongruity, urging that Nature always preserves a harmony between the colour of the hair and that of the eyes. There is statistical evidence to prove the existence of this harmony ; but to denounce, on this ground, all attempts to beautify the hair by altering its colour is tantamount to saying that Nature is perfect.

Unfortunately she is not. It would be more correct to describe her as seeking perfection through man's reason. Were she perfect, neither cosmetics nor drugs would ever be needed. Nature's colour schemes are indeed wonderful, and frequently fill our minds with admiration. So too, for example, is the mechanism she has provided man with which to see. Nevertheless, we often have to take to glasses ; and, just as we thereby improve our sight, so, too, are there cases where the personal appearance may be improved by the judicious use of hair-dyes. The fact that injudicious attempts at hair-dyeing and the use of unsuitable and dangerous substances have not infrequently caused calamities—both æsthetic and of a more serious character—provides an argument, not against the whole art of hair-dyeing as such, but in favour of a more scientific study of the subject and the dispersal of the clouds of mystification in which it is shrouded.

Proprietary hair-dyes are, one might almost say, as many as the sands of the sea ; and, without prejudice to certain admirable preparations, skilfully and scientifically blended, it should be added that the field has proved to be one only too profitable for exploitation by the charlatan. The claim that each dye is " perfectly harmless " is one invariably made, sometimes, it is to be feared, with little or no justification.

On the other hand, there is as little justification for the hysterical assertions that have been made labelling all hair-dyes as deadly poisons.

In the chapters which follow in this Part we shall indicate those dyes which are perfectly harmless, those which are definitely harmful, and those which, although containing poisonous ingredients, are not really dangerous if properly employed. We shall deal with the composition of the dyes, the chemistry of the substances of which they are made, the range of colours obtainable, and other correlated questions ; and in the next Part we shall give a detailed explanation of the technique of dyeing the hair and of such other operations (*e.g.*, shampooing and drying) as are called for in the practice of the art of Hair-Dyeing.

CHAPTER II

HAIR-BLEACHES—HYDROGEN PEROXIDE

Before dealing with hair-dyes proper, the problem of satisfactorily bleaching the hair must engage our attention. From the point of view of the effect achieved, bleaching is a sort of dyeing, and it is an essential preliminary to dyeing when a lighter colour than the original is required.

Two problems, therefore, present themselves : (*a*) the production of a satisfactory golden colour as the end in view, and (*b*) the preparation of dark hair as a preliminary to dyeing it a lighter shade. To these may be added a third, namely, the removal of dyes from the hair, usually as a preliminary to re-dyeing. Agents used for this last purpose are generally called " decolorants."

THE THEORY OF BLEACHING

It is well known that coloured fabrics tend to fade if exposed to light and air. This is due to oxidation, that is, the combination of the dye with the oxygen contained in the air. As has been pointed out in Part I., the colour of substances seems to depend on the presence in their molecules of certain (usually unstable) groupings of atoms. Any chemical change undergone by such a substance is liable to upset this grouping, and thus to destroy the colour.

Organic (or carbon containing) compounds are, usually speaking, able to combine with more or less oxygen, the resulting products differing, of course, according to the degree of oxidation undergone. Thus, to take a very simple example, if ordinary alcohol is gently oxidised, it produces acetaldehyde. A more vigorous oxidation results in acetic acid (vinegar) ; whilst, if the alcohol is set on fire, complete oxidation takes place, the products being carbon dioxide gas and water-vapour.

It can be said, therefore, that chemically similar processes take place when a coloured fabric fades and when it is burnt. Both are types of oxidation. The first process is a case of mild oxidation, only the dye being acted upon and converted into a colourless compound. In the second case, the fabric itself is more or less completely oxidised.

Although the oxygen of the air is uncombined with any other substance, the nitrogen and other gases present being merely mixed with it, nevertheless, it is not in a very active condition, bleaching being effected by it only under the influence of the actinic rays of light. The reason for this is that ordinary oxygen is really a sort of combination of oxygen with itself—the oxygen atoms being linked together in pairs to form stable molecules. When oxygen is obtained by chemical means from a compound containing it, very frequently at the moment it is set free it exists in the form of uncombined atoms, and is then very reactive. It follows that substances rich in oxygen, especially those in which the oxygen is loosely combined, are able to oxidise other substances, and thus to bleach dyes, much better than oxygen itself. Such substances are known as " oxidising agents."

There is another class of bleaching agents, whose nature is exactly the opposite to that of oxidising agents. These are known as " reducing agents," a very common one used in various industries for bleaching being sulphur dioxide. The peculiar property of these substances is their power of abstracting oxygen from other substances. They act as bleaching agents because many dyes, on losing oxygen, are converted into colourless substances known as " leuco-compounds " (leukos = white). The effects of bleaching by means of reducing agents are not always permanent, because leuco-compounds pass back again into dyes on oxidation, which change may sometimes be effected by the oxygen of the air.

Finally, mention must be made of certain bleaching agents whose actions are specific for certain colouring matters, though these, perhaps, should be called " solvents " rather than bleaching agents. Thus, oxalic acid is a reducing agent, but in addition it has good solvent powers for iron, which accounts for its use in removing ink stains.

BLEACHING AGENTS FOR THE HAIR

On the theory that the colour of dark hair is due to excess of iron, the ideal substance for converting brunettes into blondes would be a reagent capable of removing this and replacing it by sulphur. Unfortunately, such a reagent has not been discovered, and bleaching is the only process available for producing the desired effect.

Atmospheric oxygen, acting under the influence of light, constitutes the simplest possible bleaching agent for the hair. Its action is very slow ; and it is said that Italian women, in order to lighten the colour of their tresses, after treating them with a concoction made by distilling alum, black sulphur and honey with water, would sit for hours in the sun wearing hats from which the crowns had been removed.

It may be laid down as a general principle, that for the purpose of bleaching the hair, an oxidising agent must be mild in its action, non-poisonous in character, and one which produces a harmless substance when its available oxygen is given up. Two substances of this sort at once suggest themselves, namely, sodium hypochlorite and hydrogen peroxide. The first may be described as sodium chloride (that is, common salt) loosely combined with oxygen, the second as an easily dissociated compound of oxygen and water, common salt and water respectively being the substances remaining when these oxidising agents have performed their work of bleaching.

" Eau de Javel " * consists of an aqueous solution of sodium hypochlorite, and is sometimes used for decolorising dyed hair—a special problem which will be referred to again at the close of this chapter. It tends to be rather uneven in its action.

Hydrogen peroxide, however, has proved itself a most useful reagent for bleaching the hair with the production of blonde shades. It is universally employed for this purpose, and is the basis of many preparations which have been and are sold at high prices under various fancy names.

---

* The name is also applied to a solution of potassium hypochlorite whose properties are very similar to those of sodium hypochlorite.

HYDROGEN PEROXIDE

Hydrogen peroxide was discovered by a French chemist, named Thénard, in 1818, who prepared it by the action of dilute hydrochloric acid on barium peroxide. The chemical formula of the substance is H_2O_2, which indicates that each molecule of the substance contains two atoms of hydrogen and two atoms of oxygen. That of water is H_2O, each molecule of water containing only one atom of oxygen. The two atoms of oxygen in the molecule of hydrogen peroxide are not combined in the same manner, and we can best visualise the structure of the molecule by picturing it as a system formed by a planet with three moons. The planet consists of one of the oxygen atoms, the three moons being the other atom of oxygen and the two atoms of hydrogen. The "moon" atom of oxygen is loosely combined, and is very easily split off, especially in the presence of an oxidisable substance, water remaining behind. The author of an article on hair-bleaching, published a few years ago in a trade journal, lamented the ease with which hydrogen peroxide lost its extra atom of oxygen; but it is just this very fact that renders hydrogen peroxide an effective oxidising, and hence bleaching, agent.

Pure hydrogen peroxide has been prepared, and is a colourless, syrupy liquid. The commercial article, however, is a *solution* of the peroxide in water, and is sold in various strengths, expressed in terms of volumes of oxygen. The figure stated should correspond to the volume of oxygen available for purposes of oxidation, thus a "10 vols." solution should contain ten times its own volume of available oxygen, or 3·04 per cent. of hydrogen peroxide by weight. "Perhydrol" is a very strong solution containing 30 per cent. of hydrogen peroxide or about 100 vols. of available oxygen. "20 vols." is the strongest solution required for bleaching the hair.

Solutions of hydrogen peroxide gradually undergo decomposition into water and oxygen, the process being facilitated by agitation, contact with rough surfaces, the action of light, alkalies, and warmth. As every one knows who has kept bottles of hydrogen peroxide solution, the corks are sometimes blown out, especially in warm weather.

Hydrogen peroxide is usually manufactured from barium peroxide, from which it can be conveniently obtained by the action of dilute sulphuric acid. Phosphoric acid is sometimes employed in place of sulphuric. In either case, an insoluble compound of barium is produced, which is removed by filtration. To ensure complete decomposition of the barium peroxide, an excess of the acid is employed, which excess remains in the hydrogen peroxide solution. Acids tend to retard the decomposition of the hydrogen peroxide, and most samples contain small amounts allowed to remain or deliberately added as preservatives.

The exact strength of a solution of hydrogen peroxide can be determined by the analytical chemist by adding an excess of concentrated sulphuric acid and potassium iodide to a known volume, and titrating the liberated iodine with a standard solution of sodium thiosulphate. To the hairdresser, however, the variability in strength of solutions of hydrogen peroxide is a rather troublesome matter. The best advice we can give is : Buy your peroxide from a reliable manufacturer, buy it for your own use in as small quantities at a time as possible, and what supplies you have to keep, store in a dark, cool place, preferably in bottles of amber glass, coated on the inside with a thin layer of paraffin wax to form a very smooth surface. Alternatively, use one or other of the solid preparations described below.

HYDROGEN PEROXIDE IN SOLID FORM

To overcome the difficulty arising from the variability in strength of hydrogen peroxide solutions, which difficulty is much intensified in countries enjoying a warmer climate than our own, various solid preparations have been placed on the market, which, perfectly stable so long as they are kept dry, yield hydrogen peroxide on dissolution in water, giving solutions of known concentration depending on the proportion of water employed. One of the most useful of these is the condensation product which hydrogen peroxide forms with carbamide or urea, $CO(NH_2)_2$. This decomposes into these two constituents when dissolved in water (Merck's " perhydrit," German Patent No. 303,680, 1911). Alternatively, a mixture of sodium perborate with a solid organic acid, such as tartaric acid, may be employed (French Patent No. 401,911, 1909), the perborate being converted into borax and hydrogen peroxide on the addition of water.

THE RÔLE OF AMMONIA

As has been already stated, the decomposition of hydrogen peroxide, and hence its effectiveness as a bleaching agent, is increased by the addition of a small amount of alkali. Experience has shown that the best alkali to use in the case of hair-bleaching is ammonia, or, more correctly, ammonium hydroxide.

Ammonia is an invisible gas, possessing a very pungent odour. Its chemical formula is NH_3, which shows that it is a compound of nitrogen and hydrogen. It is very soluble in water, a loose combination between the ammonia and the water taking place, with the production of an alkali, having the formula NH_4OH, and called " ammonium hydroxide." The dissolution of the ammonia is accompanied by an increase in the bulk of the liquid, the density, or weight of unit volume of a solution of ammonia (or ammonium hydroxide) being less than that of water. A solution containing about 36 per cent. by weight of ammonia has a density, compared with water as 1, of ·880, and such a solution, which is the strongest employed, is known commercially as " eight eighty ammonia."

The addition of a small amount of ammonia to the hydrogen peroxide employed in the art of hair-bleaching serves several useful purposes, and without its aid the action of the peroxide is very slow. In the first place, the ammonia serves to neutralise any acid present, which would otherwise not only hinder the action of the peroxide, but possibly exercise a deleterious effect on the hair. In the second place, as already pointed out, the addition of ammonia activates the oxidising powers of the peroxide. And thirdly, the ammonia exercises a solvent action on the sebum, and thus enables the peroxide to get at the pigment, which might otherwise be shielded from it.

It seems desirable to emphasise the fact that the first action will always be that of neutralising any acid present in the peroxide. The ammonia necessary for this is used up in the process, and is not available for any further purpose. An element of uncertainty is thus introduced in the various formulæ which have been published, and which vary greatly in the proportions of ammonia recommended, owing to the fact that various makes of peroxide contain more or less acid, or, in some cases, practically none.

The amount of ammonia required to neutralise the acidity of any sample of peroxide can be easily determined by putting a measured amount of the peroxide in a white saucer, adding a little piece of blue litmus paper (purchasable at any chemist's), which will turn red, and adding ammonia drop by drop, stirring after each drop, until the colour of the paper changes back again.

IS HYDROGEN PEROXIDE INJURIOUS TO THE HAIR ?

In his work on *The Preservation of the Hair*, published in 1910, Dr. R. W. Leftwich gives the result of a very interesting series of experiments carried out to determine the effects of various substances on the human hair. The strength of hairs was measured by the maximum force which each would withstand; and, having obtained a supply of hairs of uniform strength, Dr. Leftwich determined their strengths after treatment with the various reagents. Strong ammonia " reduced the hair to the condition of a soft, gelatinous thread." A solution containing about 10 per cent. of ammonia decreased its strength by about two-thirds; but the effect of a weaker solution, containing about 1·2 per cent. of ammonia (or, say, 1 drop of ·880 ammonia to 25 drops of water), was transitory, the hair recovering its original strength as the odour of the ammonia passed off. Strong acids rendered the hair very brittle. *Hydrogen peroxide, however, had little or no effect on its strength.*

This last result is very interesting, because there is a belief current in the hairdressing trade that bleaching damages the cuticle of the hair, and tends to make it very brittle.

In considering this question, it would appear to be necessary to take into consideration not only the strength of the peroxide employed, but also the action of any impurities present and of the added ammonia. The peroxide employed by Dr. Leftwich is stated to have been free from impurities and was used without ammonia. After commenting on its bleaching effects, he writes : " I found that the hair which had been soaked in the peroxide was practically unaltered in strength. Apart from the dryness, its use may be considered harmless."

In order to throw further light on this highly important question, we made a careful microscopical examination of hair bleached by means of peroxide, with the addition of ammonia, in accordance with the method described later in this book, comparing this with a sample of the original hair. We could detect no damage to the cuticle whatever, and are led, therefore, to a conclusion in harmony with that arrived at by Dr. Leftwich. The effect of injudicious and excessive use of peroxide is, of course, another matter, and that such use may prove very harmful to the hair, we should certainly not deny.

DECOLORANTS

Closely allied to the problem of bleaching the natural colour of the hair is that of removing from the hair a no longer desired dye. Various substances have been used, or suggested for use, to solve one or other, or both, of these problems. We mention potassium cyanide first, only in order to point out that, under the action of carbonic acid gas (which is present in the atmosphere), potassium cyanide evolves hydrocyanic (or prussic) acid, one of the most deadly poisons known. We have no hesitation in saying that *in no circumstances should potassium cyanide be used for any cosmetical purposes whatever.*

When the nature of the dye to be removed is known, the problem of decolorising is rendered less difficult. But if, as generally happens, this is not the case, experimentation is necessary, which—it seems hardly necessary to say—should never be carried out on the head, but on a piece of hair cut from behind the ear.

Many dyes yield to hydrogen peroxide, activated by the addition of ammonia ; and this reagent should be tried first.

Failing success, a 10 per cent. solution of photographic " hypo " —sodium thiosulphate, $Na_2S_2O_3 . 5H_2O$, often miscalled " sodium hyposulphite "—will be found useful, especially in the case of metallic dyes. This solution must be freshly prepared and acidulated with 2 per cent. of concentrated sulphuric acid.* It acts as a reducing agent.

Oxalic acid, used in an aqueous solution containing not more than 4 per cent., is also a good dissolvent; but its use needs great care, as the substance is very poisonous and corrosive.

Further information concerning bleaching and decolorising will be found in later chapters as follows: on the use of potassium permanganate as a bleaching agent in Chapter VII. of the present Part; on the practical side of bleaching in Chapter V. of Part III.; and on the practical side of decolorising in Chapter VI. of the same Part.

---

* This substance is very dangerous and must be handled with the greatest possible care. Neither the concentrated acid nor strong solutions of it must ever be allowed to come into contact with the skin. Water must never be poured on to the strong acid, but solutions always prepared by adding the acid to the water. Disregard of these precautions may eventuate in serious accidents.

CHAPTER III

KOHL

KOHL, used by the women of the East to give a " long, dark languish to the eye," is surrounded by the glamour of romance, the word conjuring up visions of the dark-eyed beauties of the Orient. It is, by the way, sometimes spelled " kohol," and, less frequently, " kheul."

Originally, kohl was made from finely powdered stibnite. This mineral is a crystalline form of antimony tri-sulphide (Sb_2S_3), which occurs native in several places. It is greyish black in colour, and marks the hands, if touched, in the same manner as graphite. Its use is decidedly dangerous, owing to its liability to become oxidised and absorbed into the system. There is a fine collection in the British Museum of various types of vases, some very artistic in design, used by the ancient Egyptians to contain kohl. Three different types are shown in the sketch (Fig 3).

Another form of kohl used in the East, more akin to the Western product, is said to be made by burning almond shells and aromatic resins and collecting the soot. A correspondent in Tunis sent Rimmel (*The Book of Perfumes*) a more elaborate recipe : " They remove the inside of a lemon, fill it up with plumbago and burnt copper, and place it on the fire until it becomes carbonised ; then they pound it in a mortar with coral, sandal-wood, pearls, ambergris, the wing of a bat, and part of the body of a chameleon, the whole having been previously burnt to a cinder and moistened with rose-water while hot."

Thus prepared, kohl could hardly be described as a simple dye. But these fantastic ingredients, of course, are quite unnecessary, the product owing its tinctorial properties to the finely divided carbon produced as a result of the incineration of the ingredients.

When any combustible substance, such as tar, resin, turpentine or petroleum, is burnt in a supply of air insufficient for complete combustion, soot or lampblack is formed, as in a smoky lamp. Lampblack consists of very finely divided, amorphous carbon, together with about 20 per cent. of oily and fatty matters, and finds wide application as a black pigment. Indian (or Chinese) ink is manufactured from the densest and

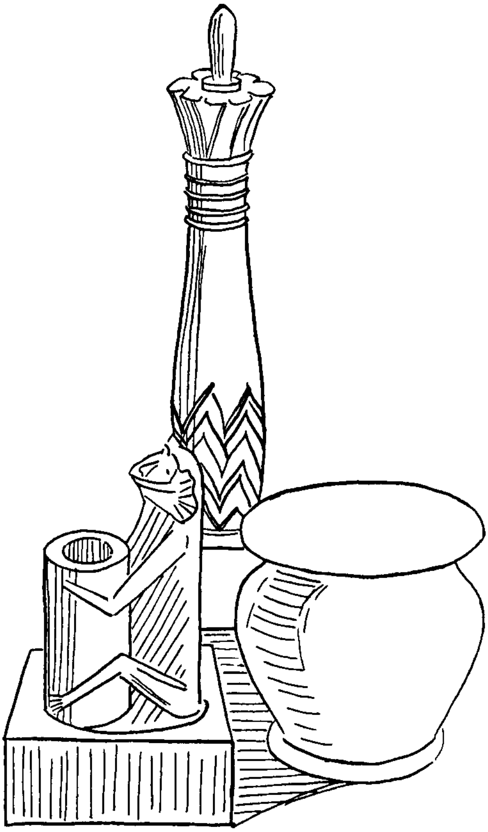


FIG. 3.—TYPES OF ANCIENT EGYPTIAN KOHL VASES from the British Museum Collection.

(By kind permission of Dr. Hall, Keeper of the Egyptian and Assyrian Antiquities.)

purest lampblack, a proportion of gum or gelatine being added to bind the particles of carbon together; and it provides, when finely powdered, a useful form of carbon for the preparation of kohl. Charcoal, which is made by carbonising wood (vegetable charcoal) or bones and other animal material (animal charcoal), can also be employed. The finest form is known as "ivory black." This should be made by igniting waste pieces of ivory, turnings, dust, etc.; but, nowadays, the term is often applied to any fine animal charcoal. Charcoal made from bones or ivory contains a high percentage of calcium phosphate in a porous form, in the pores of which very fine particles of amorphous carbon are deposited, and forms an excellent pigment for preparing kohl.

PREPARATION OF KOHL

To prepare a useful and completely harmless form of kohl, all that is necessary is to suspend finely divided amorphous carbon in a mucilage of gum acacia or gum tragacanth, the latter, perhaps, being the better.

If gum acacia is employed, the powdered pigment is well mixed with about its own weight (or less, if Indian ink is used) of the powdered gum, a few drops of a suitable essential oil (*e.g.*, clove oil) is added, which serves, not only to perfume the kohl, but also to preserve it, and rose-water is gradually poured on the mixture, the powder being well ground in to produce a liquid of uniform consistency, about 8 c.c. * of rose-water being used for each gram of pigment.

If gum tragacanth is employed, the mucilage is prepared first, in accordance with the following formula:—

Gum tragacanth	1·25 gram.
Alcohol, 90 per cent. . . .	2·5 grams.
Rose-water	100 c.c.

The finely powdered gum is first well mixed with the alcohol, the rose water then added as rapidly as possible, and the mixture vigorously shaken. The pigment is then ground in.

---

* See "Note on Weights and Measures" at the end of this chapter.

USES OF KOHL

The colouring matter of kohl is not combined with the substance of the hair in any way, nor is it deposited within the hair, being merely attached to the surface and caused to adhere by the gum. Strictly speaking, therefore, kohl should be described, not as a dye, but, rather, as a paint. It is removed from the hair by washing, and consequently is of limited utility, being chiefly employed for colouring the eyelashes and eyebrows, and for touching up the moustache and stray grey hairs about the temples in the case of persons whose hair is naturally black. It is usually applied by means of a small brush or stick.

Kohl in the form of a paste, very useful for theatrical purposes, can be made by grinding amorphous carbon with vaseline kept warm during the operation, a few drops of essential oil being added as a perfume. This should be warmed before application to the eyelashes, and applied by means of a small stick.

NOTE ON WEIGHTS AND MEASURES

For all scientific purposes, the chaotic English system of weights and measures, remarkable chiefly for its complexities and ambiguities, has been entirely superseded by the metric system, which is simplicity itself. In this latter system, which is employed throughout this book, the unit of weight is the GRAM. The corresponding unit of volume is the CUBIC CENTIMETRE or millilitre.* At ordinary temperatures, a gram of distilled water and a cubic centimetre of distilled water may for practical purposes be taken as identical. A LITRE is a larger unit of volume, containing one thousand cubic centimetres.

For purpose of comparison, it may be added that a gram is equivalent to 15·432 grains,† and a litre is very nearly equal to 1¾ pints. If, however, it is required to transform formulæ written in the metric system into any other system of weights and measures, the easiest plan, seeing that it is only the proportions of the various ingredients which matter, and not the actual amounts of them specified, is to write " parts by weight " in place of " grams " and " parts by volume " in place of " cubic centimetres," and then to substitute the units required.

Our advice to readers wishing to use this book as a practical manual, however, is not only to carry out all measurements by the aid of the metric system, but to learn to think in this system, as much unnecessary labour is thereby saved.

The abbreviation " c.c." is used for " cubic centimetre(s)."

---

* Strictly speaking, these are not identical, but for practical purposes the difference between them is negligible.

† *I.e.*, 1 oz. avoirdupois = 28⅓ grams approximately.

CHAPTER IV

HAIR RESTORERS—LEAD DYES

MANY are the theories which have been put forward to account for the greying of hair as age advances. Increase in the number of air-spaces in the hair ; decreases in the amount of the pigment or a change in its composition ; thickening of the cuticle, whose opacity hides the colour, are among the causes which have been suggested in explanation of this unkindly phenomenon, which will be considered more fully in Part IV. of this book.

As pointed out in Part I., the view is commonly held that the elements iron and sulphur are essential constituents of the pigments of the hair, the iron being especially responsible for the colour in black hair. On the assumption, therefore, that greying is caused by a decrease in the amount of the pigment or a change in its chemical composition, it ought to be possible to restore grey hair to its former colour by administering these elements, either internally or externally, in a form in which they will be assimilated and combined with the other necessary elements to reproduce the lost pigment.

So far as the first method suggested is concerned, the Chinese are said to have known for ages the secret of how to retain their raven locks by drinking ferruginous waters. Nevertheless, in spite of the claims at one time put forward on behalf of hæmoglobin—the red colouring matter of the blood which contains iron—no plan of administering any form of iron or sulphur internally has proved successful in restoring the colour of grey hair.

So far as external methods of applying these elements are concerned, the problem, on the face of it, seems a less difficult one to solve. However, the defence of the man charged with hitting his grandmother on the head with a poker, that he did not wish to injure the old lady, but merely to restore the colour of her hair, cannot be described as scientifically sound. Nor can the claims of most hair restorers.

IRON RESTORERS

Many erroneous notions have been and are entertained concerning the nature of the pigments of the hair and the possibility of restoring the colour when greyness has set in. For example, it has been stated that the pigment is simply iron sulphide—presumably because this substance happens to be black and to be composed of iron and sulphur—and a little booklet boosting, among other preparations, a hair restorer said to contain this substance had quite a big circulation at one time. The iron and sulphur in the hair are present, of course, in an organic form, that is to say, combined with carbon and other elements in a complex manner ; and no form of iron (or sulphur) less likely to be assimilated than iron sulphide could, owing to the insoluble character of this substance, be well imagined.

It is a rather interesting fact—though it would be unwise to attempt to press the analogy too far—that if plants are grown in culture solutions containing all the elements essential for their nourishment with the exception of iron, the stems and leaves are usually of a pale yellow colour. This is due to the fact that iron is necessary for the development of the chlorophyll or green colouring matter, though, curiously enough, the latest researches on this substance demonstrate that iron is not actually a constituent of it. Washing the leaves of plants grown under these conditions with a weak solution of a salt of iron is, however, often all that is necessary in order to cause the green colour to develop.

Similar treatment has been recommended for restoring the colour of grey hair. The following from Askinson's *Perfumes and Cosmetics* is a typical hair restorer based on a salt of iron* :—

Iron (ferrous) sulphate . . .	1 part.
Glycerine	4 parts.
Eau de Cologne	4 ,,
Rose-water	56 ,,

---

* See Part IV. for an alternative formula.

and is a perfectly harmless preparation. Iron sulphate, or, more correctly, ferrous sulphate, is commonly called " green vitriol " because it forms green crystals. These have the chemical formula $FeSO_4 . 7H_2O$, and contain about 20 per cent. of iron. The purest product only should be employed in making up the above formula.

Unfortunately, however, perhaps owing to its horny character, perhaps due to the nature of the pigment itself, hair does not assimilate iron in the easy manner of plants, and the action of an iron restorer, such as the above, is, at the best, slow. As an improvement on this method of treatment, it has been suggested to treat the hair, twenty-four hours after the application of the iron salt, with a weak solution of ammonium or other alkaline sulphide.* This, however, is simply dyeing, the two substances reacting to deposit black iron sulphide (FeS) on the hair. The colour is not very satisfactory, and the use of substances, like ammonium sulphide, redolent of rotten eggs, is objectionable.

LEAD DYES

Most, if not all, of the hair restorers on the market are, actually, not restorers, but simply dyes, usually with a lead basis. At one time the use of combs made of lead was advocated to prevent hair from becoming grey, particles of the lead combining with the sulphur in the hair to form lead sulphide (PbS), which is an insoluble black substance.

An early form of lead dye was prepared by dissolving freshly precipitated lead hydroxide in a solution of caustic potash, with the production of potassium plumbite, a particularly objectionable form in which to use this very dangerous metal, lead.

Lead dyes, in fact, were so much employed about a century ago as to cause lead and lime to be described as " the sheet anchor with the barbers."

Innumerable formulæ for lead dyes have been published, the chief ingredients being lead acetate, $Pb(C_2H_3O_2)_2 . 3H_2O$, and precipitated sulphur, or lead acetate and sodium thiosulphate. In neither case are the two elements, lead and

---

* Regarding these substances, see Chapter V. of the present Part.

sulphur, present in forms in which they readily combine to form the desired pigment, lead sulphide. Such dyes, therefore, are necessarily slow in their action, the colour produced gradually passing—provided the use of the dye is continued—from yellow, through red-brown, to a dull black. Dyes which act in this slow manner are distinguished as "progressive dyes." Lead acetate, it may be added, forms white crystals containing about 55 per cent. of lead. It is sometimes called "sugar of lead."

The following is a typical formula for a progressive lead dye containing "hypo":—

Lead acetate	20 grams.
Hypo (sodium thiosulphate) . .	30 ,,
Glycerine	40 c.c.
Perfumed alcohol	60 ,,
Distilled water or rose-water to .	1 litre.

The lead acetate and "hypo" are separately dissolved in part of the water and afterwards mixed, and the bottle containing the preparation is well shaken each time before using.

More Secret Remedies, published by the British Medical Association in 1912, contains the results of analyses of three well-known proprietary "hair restorers" all containing lead acetate and sulphur, which are here reproduced as typical of this class of preparation:—

	No. 1. Parts by weight.	No. 2. Parts by weight.	No. 3. Parts by weight.
Precipitated sulphur . .	1·3	1·4	3·2
Lead acetate . . .	1·6	0·13	1·8
Glycerine	9·6	19·0	5·7

Rose-water to produce 100 parts by measure in each case.

A small quantity of lead sulphate was found to be present in No. 1, probably produced as the result of chemical reactions between the constituents accompanied by oxidation. On this assumption, the amount of lead acetate originally present would be 2·1 parts. A second sample of No. 2 contained

0·97 parts of lead acetate, or about seven times as much as the first.

If desired, a preparation of this character can be made as follows: Rub down precipitated sulphur to a smooth paste with glycerine, diluting with a little distilled water. Then add the lead acetate separately dissolved in a sufficient quantity of distilled water, with constant stirring, and finally dilute. Rose-water or orange-flower water may be employed in place of distilled water, or other perfumes introduced. Suggested proportions are:—

Precipitated sulphur . . .	15 grams.
Glycerine	30 c.c.
Lead acetate	15 grams.
Distilled water or rose-water to .	1 litre.

The mixture must be well shaken both before bottling and before use.

Relatively few cases of lead poisoning as a result of using lead hair-dyes appear to have been reported, and lead dyes possess the advantage of not staining scalp or linen. Nevertheless, the dangerous character of preparations containing lead must not be unduly minimised, especially in view of the serious effects of lead poisoning. Moreover, such dyes are little, if at all, employed nowadays by the skilled hairdresser, being mainly sold for home usage where necessary precautions in employing them are most unlikely to be taken.

Unfortunately, some folk have an unreasonable prejudice against hair-dyeing, and will continue the use of a not very effective dye, because it doesn't look like a dye and is called a " restorer," rather than go to a hairdresser and have the job of dyeing properly and effectively done.

A SIMPLE TEST FOR LEAD

A simple test, which may be used to detect the presence of lead in a hair-restorer, is effected by mixing the dye with nitric acid, then decanting off a little of the clear liquid, or filtering a little, if this procedure is preferred, and adding a small quantity of concentrated hydrochloric acid to it. If a lead compound, such as lead acetate, is present in appreciable amount, the solution will go milky, owing to the formation of lead chloride ($PbCl_2$), which is almost insoluble in cold water. To be certain that the milkiness is due to lead (and not to silver or certain compounds of mercury, which also give this reaction), the milky liquid must be diluted with distilled water and boiled. If lead is present the liquid will clear on boiling, and deposit white crystals as it cools.

CHAPTER V

SILVER DYES

In the last chapter, hair-dyes based on lead were dealt with, and certain preparations making use of compounds of iron have been considered. Compounds of several other metals are also used in the composition of hair-dyes, of which silver calls for special notice. Silver dyes are usually put up in two solutions, which are applied to the hair one after the other, the constituents immediately reacting to produce a coloured substance on—or, in so far as the solutions penetrate, in—the hair. Dyes, like these, which take effect immediately, are known as " instantaneous," to distinguish them from the slowly acting progressive dyes. The colour produced by means of silver dyes is very permanent, and, in view of the tenacious character of the stains formed when silver nitrate acts on the skin, it may be surmised that some form of chemical reaction takes place between the silver and the keratin. The formation of black silver sulphide (Ag_2S) is in any case to be anticipated.

Generally speaking, it may be said that if a dye with a toxic metallic base is to be used at all, instantaneous are preferable to progressive dyes. With the former, other things being equal, there is less likelihood of poisoning, provided the hair is well washed after the dye has taken effect, in order to remove all soluble bodies. The one disadvantage—if it may be so called—from which instantaneous dyes suffer, is that they frankly proclaim themselves as dyes, and cannot be camouflaged as " hair restorers."

THE CHEMISTRY OF ACIDS AND SALTS.

Before proceeding further with a practical consideration of silver and other metallic hair-dyes, it may be desirable to explain a few points of chemical theory, as this will greatly facilitate the understanding on the part of the non-scientific reader of the composition and action of this class of dyes.

The metallic compounds with which we have to deal are those classed by chemists as " salts," and it is very necessary clearly to comprehend what a salt is, and the relation which exists between salts and acids. Without, however, going into this matter fully, which would take us too far into scientific theory, it will be sufficiently accurate to say that an " acid " is a substance containing the element hydrogen, and is of such a nature that the hydrogen can be replaced by a metal. When this replacement is effected, whether by direct or indirect means, the resulting substance is called a " salt."

The man in the street generally has a great dislike for long scientific names, and some hairdressers, it is to be feared, share this taste. As a matter of fact, however, whereas the popular names of, for example, plants and drugs tell one very little about them, the " long scientific names " are so constructed as to convey the maximum amount of information.

The scientific method of naming common acids and salts is a case in point. Many acids contain oxygen ; some do not ; and this fact is made use of in naming them, according to the following table :—

	Acid.	Salt.
No oxygen	Hydro——ic.	——ide.
Little oxygen	——ous.	——ite.
Much oxygen	——ic.	——ate.

Thus, *hydro*chlor*ic* acid is a substance containing the elements chlorine and hydrogen, but no oxygen ; whereas sulphur*ous* and sulphur*ic* acids both contain oxygen in addition to hydrogen and sulphur, the former containing less oxygen than the latter.

The names of salts each consist of two words, the first being the name of the metal, the second referring to the acid. The rules for naming simple salts are also shown in the above table. Thus, copper chloride is the salt obtained by replacing the hydrogen of hydrochloric acid by copper ; similarly sodium sulphite is the sodium salt of sulphurous acid, silver nitrate is the silver salt of nitric acid, and so on.

When two salts soluble in water are mixed together in solution, the solution behaves as though all four possible salts were present, providing these are all soluble. Thus, a solution of sodium nitrate mixed with one of potassium chloride can be regarded as containing, not only these two salts, but also sodium chloride and potassium nitrate as well. If, however, one of the four possible salts is insoluble, the equilibrium is disturbed, owing to the fact that this salt is thrown out of solution or precipitated, and the formation of the insoluble salt will continue until all the necessary metal or acidic residue is used up. This phenomenon is known as " double decomposition." We have already met with an instance of it in the use of a solution of ferrous sulphate followed by one of ammonium sulphide as a hair-dye, these two substances undergoing double decomposition on or in the hair, with the formation of ferrous sulphide (black, insoluble) and ammonium sulphate, which latter substance remains in solution and is washed away.

One more point and we shall be in a position to pass on to the practical consideration of instantaneous hair-dyes with a metallic base. The important subject of oxidation has been dealt with in a previous chapter. Now, the fact must be emphasised that when oxidation takes place, that is to say, when a substance combines with oxygen, unless oxygen itself is the oxidising agent used, the oxygen must come from some other substance. This substance, therefore, undergoes the reverse process, namely, loss of oxygen, or " reduction." Both terms " oxidation " and " reduction " are used by chemists with extended meanings, but it will not be necessary for us to concern ourselves at the moment with these.

COMPOSITION OF SILVER DYES

The basis of silver hair-dyes is silver nitrate, a white crystalline salt obtained by dissolving silver in nitric acid and containing about 64 per cent. of silver. Its chemical formula is $AgNO_3$. It is very soluble in water. The solutions become discoloured under the action of light, and should therefore be kept in the dark. Silver nitrate is poisonous, and is a very caustic substance, as its common name of " lunar caustic " indicates. If allowed to come into contact with the skin, it leaves a black mark, which it is not particularly easy to eradicate.

It may here be added that ordinary tap water should not be used for preparing solutions of silver salts, as it contains ingredients which react with these, producing a turbidity. Indeed, it is always best to use distilled water for making hair-dyes. Rose-water, or orange-flower water, may, however, be employed when a perfumed dye is desired.

Two types of silver dyes may be distinguished. In one, the pigment, consisting of silver sulphide, a black substance, is produced, through double decomposition, by treating the hair with two solutions, one containing silver nitrate dissolved in water,* the other an alkaline sulphide, *i.e.*, a sulphide of sodium, potassium or ammonium. The reaction which takes place may be represented thus :—

$$\underset{\substack{\text{Silver}\\\text{nitrate}}}{2AgNO_3} + \underset{\substack{\text{Potassium}\\\text{mono-sulphide}}}{K_2S} = \underset{\substack{\text{Silver}\\\text{sulphide}}}{Ag_2S} + \underset{\substack{\text{Potassium}\\\text{nitrate}}}{2KNO_3}.$$

Apart from other considerations, the method may be objected to on the grounds of the rotten egg odour of sulphuretted hydrogen which is its inevitable concomitant. A more serious objection is based on the fact that the alkaline sulphides are caustic bodies, having a very deleterious action on the hair, being used, as we have indicated in Part I., for the preparation of depilatories. Sodium mono-sulphide, for example, is often recommended for hair-dyeing purposes ; but we have found a 5 per cent. solution of this substance capable of reducing hair to a fragile gelatinous mass ; and injudicious use of alkaline sulphides has been responsible for ladies going to have their hair dyed returning with their hair in their handbags. The least harmful alkaline sulphide is " liver of sulphur," a mixture of potassium polysulphides with potassium thiosulphate obtained by heating potassium carbonate with sulphur in a

---

* Or an ammoniacal solution can be used, prepared as described on p. 39.

covered vessel. This may be employed in solutions containing up to 5 per cent.

The second method makes use of the fact that alkaline solutions of silver are very readily reduced, with the production of silver itself, not, as we are accustomed to think of it, as a white shining metal, but, under proper conditions, in the form of a black powder.

An alkaline silver solution can be very easily prepared by cautiously adding a solution of ammonia to one of silver nitrate. A brownish precipitate of silver hydroxide is first formed by double decomposition. This substance is readily soluble in ammonia, and more of the solution of ammonia is, therefore, slowly added, the mixture being shaken after each addition, until the precipitate dissolves with the production of a clear liquid.

As reducing agents, tannin or gallic acid * may be employed ; but the more usual reagent is pyrogallol.

PYROGALLOL AND ITS USE IN SILVER DYES

Pyrogallol, well known to photographers as a developer under the familiar name of " pyro," is sometimes called " pyrogallic acid." But, although the substance possesses some acidic properties, the name is misleading, because pyrogallol belongs to the class of bodies known as " phenols " by chemists, being 1, 2, 3-trihydroxy-benzene, $C_6H_3(OH)_3$.

Pyrogallol forms white crystals which are easily soluble in water, and less easily soluble in alcohol. It is poisonous, and, being mainly prepared from gall-nuts, would seem to provide an exception to the rule that the vegetable substances used in hair-dyeing are harmless. Two to four grams have proved sufficient to kill a healthy dog ; and if pyrogallol gets into the eye or a fresh cut, serious trouble is likely to be caused. Apart from its poisonous properties, pyrogallol was found by Dr. Leftwich (*The Preservation of the Hair*) to render the hair brittle, immersion of hairs for half an hour in a 10 per cent. solution reducing their strength by 16 to 36 per cent. in different cases.

On the other hand, M. Schueller (*De l'innocuité des teintures*

---

* These substances are described in the next chapter.

pour cheveux) regards pyrogallol as an innocuous ingredient of hair-dyes, providing the proportion present does not exceed 5 per cent. in the case of a liquid dye.

SOME PRACTICAL DETAILS

Silver dyes can be prepared to produce a range of shades from ash-blonde to black, according to the strengths of the solutions employed, the sulphide method being the better for the lighter shades, the pyrogallol method (or a combination of both methods) being employed for the production of dark ash-brown and black.

Many formulæ have been published, some containing as much as 10 per cent. of silver nitrate. Such large quantities are both dangerous and unnecessary. Five per cent. of silver nitrate may be taken as the maximum strength for a black dye. For lighter shades, the proportion may vary from 2 per cent. or less upwards. Ammoniacal solutions are made as already described; thus, for example, to prepare a litre of 5 per cent. ammoniacal silver nitrate, 50 grams of silver nitrate are dissolved in, say, 500 c.c. of distilled water; 0·880 ammonia is added little by little, until the precipitate first formed dissolves; and then the solution is made up to a litre with more distilled water.

Pyrogallol solutions are prepared by dissolving this substance in water, or in a mixture of water and alcohol containing 1 part of alcohol to about 4 parts of water. Similar remarks apply concerning the strength of these solutions as in the case of those containing silver. Solutions varying in strength from 1 to 4 or 5 per cent. at most are sufficiently strong for all shades. Stronger solutions of pyrogallol are most emphatically dangerous to employ; Cerbelaud, indeed, in his *Formulaire des principales spécialités de parfumerie et de pharmacie*, fixes the limit of safety at the very low figure of ½ per cent., which, unfortunately, is insufficient for the production of satisfactory shades.

Suitable alkaline sulphide solutions for light shades can be prepared, as already indicated, by dissolving not more than 5 per cent. of liver of sulphur in water, and adding a perfume to mask the objectionable odour.

The silver solution may be applied to the hair (after preliminary defatting) first or second. We prefer the former of these methods, which we have found to give the better results. If applied first, the silver solution is followed in a few minutes by the sulphide solution or pyrogallol solution. Some authorities recommend, when the latter process is adopted, following the pyrogallol solution with an application of a sulphide solution, in order to produce a good black and to correct any false metallic appearance.

As illustrative of the general principles underlying the preparation of these dyes, two typical formulæ are given.

A (FOR ASH BLONDE)

No. 1.		No. 2.	
Silver nitrate	20 grams.	Liver of sulphur	20 grams.
Ammonia	*q.s.*	Perfume	*q.s.*
Water	to 1 litre.	Water	to 1 litre.

B (FOR BLACK)

No. 1.		No. 2.	
Silver nitrate	50 grams.	Pyrogallol	40 grams.
Ammonia	*q.s.*	Water	to 1 litre.
Water	to 1 litre.		

Thorough washing of the hair after dyeing with a silver dye is essential, in order to remove all traces of soluble matter, which might otherwise be absorbed by the skin and set up irritation. It is a precaution usefully taken with other dyes as well.

Great care is necessary in applying silver dyes not to allow any of the silver solution to come into contact with the skin, otherwise black stains may be produced. Should this accidentally occur, a special solvent has to be employed. The most effective is a solution of potassium cyanide, which substance is sometimes used for this purpose, and also for decolorising hair dyed with silver. But, as already pointed out, potassium cyanide is so deadly a poison that it ought never to be employed in cosmetics. Potassium iodide has been proposed as an alternative. Another plan is to dab the spots repeatedly with a 4 per cent. solution of sodium mono-sulphide and then to wash them well with soap and water.

In skilful hands, silver dyes are capable of producing good blacks, having more brilliance than those obtained by means of iron, as well as lighter shades, all, however, belonging to the ash series. Moreover, *if due care is taken and too strong solutions are avoided*, the use of these dyes does not present any serious danger. The reduction of silver compounds by pyrogallol, however, is not quite so simple as it sounds. Silver is a polychromatic metal, and cases have been known when, instead of the desired brown or black, dyes based on this metal unskilfully compounded and applied have resulted in shades of a distinctly green tone. They cannot, therefore, be regarded as ideal; and, although certainly by no means obsolete, are less employed in England and France than formerly. It may be added that silver dyes can be much improved, in so far as the range of shades and tone of the colour are concerned, by the addition of the salts of other metals, a matter which will be fully considered in Chapter VII. of the present Part.

CHAPTER VI

TANNIN—RASTICKS

THE term " tannin " is a general one, being applied to a not very well defined group of substances, fairly widely distributed in the vegetable kingdom. Tannins occur naturally in some plants, whilst in others they are formed as the result of injuries inflicted by the stings of insects, as in the case of gall-nuts on oak trees. Tannins are, speaking generally, soluble in water, they possess an acid, astringent taste, form dark-coloured compounds with iron (ink), precipitate gelatine from aqueous solutions, and, owing to their power of converting animal hides into leather, find extensive application in tanning. They are bodies of complex chemical constitution, concerning which a great deal is not known with certitude. It will be sufficient from the chemical point of view to say that they are derivatives of gallic acid, which is a trihydroxy-benzoic acid, $C_6H_2(OH)_3COOH$.

Common tannin, or tannic acid, occurs in tea, sumach (*Rhus Coriaria*) and other plants, and to the extent of 50 per cent. or more in gall-nuts, from which latter source it is mainly obtained. Most samples are brownish yellow in colour, and usually contain gallic acid, which also occurs in gall-nuts. When pure, tannic acid is white. It dissolves easily in cold water, and, owing to its property of forming a blue-black, insoluble compound with iron, is capable of being used, in combination with iron salts, as a dye.

In this connection it should be pointed out that two series of iron compounds are known having quite different properties, corresponding members of the two series differing from each other in the amount of iron they contain. One set of compounds is distinguished as " ferric," the other as " ferrous " (from the Latin word *ferrum* = iron), the members of the first series containing less iron than corresponding members of the latter. When a solution of *pure* ferrous sulphate is added to one of tannin, a white cloudiness is formed ; but, on the other hand, if a solution of ferric chloride is used, a blue-black pigment results. In actual practice, however, the final result is the same, because ferrous compounds easily become oxidised on exposure to the air with the formation of the corresponding ferric compounds.

It may be added that the two salts of iron most employed in hair-dyeing are ferrous sulphate, already mentioned, and ferric chloride, Fe_2Cl_6. The latter substance occurs in yellow, deliquescent lumps, containing, when pure and dry, about 34 per cent. of iron.

USES OF TANNIN

Tannin itself has not many applications as a hair-dye. It is sometimes employed in the dyeing of postiche to help to fix other dyes, a use which will be referred to again in a later chapter. Apart from this application, however, formulæ have been published in which use is made of gall-nuts combined with salts of iron ; and there is a homely recipe for a hair darkener, according to which equal parts of green tea and garden sage are infused in thirty times their combined weight of hot water in an iron pot, and the liquid allowed to simmer until reduced to one-third of its bulk.

Mention must also be made of the use of powdered gall-nuts and ferrous sulphate in conjunction with henna, a combination which has much to commend it on the ground of harmlessness, and which will be referred to again in a later chapter. It may here be pointed out, however, that iron dyes have been criticised as producing results lacking in brilliance.

RASTICKS

From early times, pastes have been used in Turkey for dyeing the hair, known as " rasticks," in the preparation of which gall-nuts play an essential part. The powdered gall-nuts are first heated alone in a copper vessel. The product is powdered, moistened with water, and, after further heating, copper and iron filings are incorporated in the mass, a little musk being also added as a perfume. The proportions, according to

Durvelle (*The Preparation of Perfumes and Cosmetics*), are as follows :—

Powdered gall-nuts . . .	2,000 parts.
Iron filings	50 ,,
Copper filings	2 ,,
Musk	2 ,,

The resulting paste is applied to the hair, allowed to remain in contact with it for a couple of hours or so, after which the hair is thoroughly washed.

Now when either tannic or gallic acid is heated, it loses carbon dioxide and is converted into pyrogallol, and the term " rastick " is employed nowadays to designate hair-dyes composed of this substance in combination with a salt of iron * or copper or both.

It may be added that alkaline solutions of pyrogallol rapidly become brown on exposure to the air, oxygen being absorbed with the production of substances of complex chemical structure ; and, further, that, owing to this property, pyrogallol can be used, preferably dissolved in weak alcohol, to dye the hair brown, without the admixture of other substances. The oxidation may be hastened by the use of a second solution containing potassium dichromate.† Formulæ have been published by Stitson (*The Human Hair : its Care and Preservation*) and others. We do not, however, reproduce these, as such dyes are distinctly dangerous and appear entirely to have been replaced by those containing metallic salts in addition to the pyrogallol. A formula for a pyrogallol dye used for postiche purposes is, however, given in a later chapter.

MODERN RASTICKS

If perfectly pure solutions of pyrogallol and ferrous sulphate are mixed together, the immediate result is merely a slight white milkiness ; but if a little *ferric* salt is present in the ferrous sulphate, as is nearly always the case owing to slight oxidation, a blue-black substance is formed. The reaction

---

* Nickel and cobalt, which in some respects resemble iron, can also be employed and are especially useful (see Chapter VII. of this Part).

† Often miscalled " potassium bichromate."

appears to be the result of oxidation of the pyrogallol plus combination with the iron, and is of a much more complex character than that between pyrogallol and ammoniacal solutions of silver, in which latter reaction the pyrogallol is oxidised to acetic and oxalic acids. A rather similar reaction takes place in alkaline solution between pyrogallol and copper sulphate; and, by the aid of copper salts and pyrogallol, preparations to dye hair brown can be made. Salts of iron and copper mixed together can be employed in conjunction with pyrogallol for the production of darker shades.

Copper sulphate, it may be added, forms blue crystals having the chemical formula $CuSO_4 . 5H_2O$, containing about 25 per cent. of copper. It is commonly called "blue vitriol." Copper (cupric) chloride is another salt used for making hair-dyes. The anhydrous (free from water) salt, $CuCl_2$, forms a brown mass, containing about 47 per cent. of copper. Greenish blue crystals having the formula $CuCl_2 . 2H_2O$, and containing about 37 per cent. of copper, can also be obtained.

Rasticks prepared with the above described ingredients are most effective if used in pack form, and are largely employed nowadays in combination with henna. Further details concerning these dyes will be found in Chapter XI. of the present Part. Rasticks can also be prepared in liquid form, though, in order to obtain effective results, certain difficulties have to be overcome.

A very good method for preparing liquid rasticks was patented by M. Schueller in France in 1907 (French Patent No. 383,920), the process making use of suitable reducing agents in combination with solutions of pyrogallol (or other phenolic bodies) and metallic salts. As explained in a previous chapter, a reducing agent is exactly the reverse of an oxidising agent, and by adding a suitable substance of this character—for example, sodium sulphite—the reaction between the pyrogallol and the metallic salt can be held up, until the liquid, being actually applied to the hair, is subjected to the action of atmospheric oxygen. Formulæ for dyes of this type containing salts of cobalt and nickel will be found on p. 55.

More Secret Remedies, published by the British Medical Association in 1912, contains analyses of two dyes, very popular at the time, based on pyrogallol and copper. The compositions of these dyes, both of which were described as "brown," were as follows :—

	No. 1.	No. 2.
Pyrogallol	3·8 parts.	2·1 parts.
Copper chloride (anhydrous) . .	1·8 „	1·3 „
Hydrochloric acid (B.P. strength) .	0·75 „	0·3 „
Sulphuric acid	0·07 „	*Nil.*
Water	to 100 „	to 100 „

The free acid present would tend to hold up the formation of the colouring matter until applied to the hair, though less effectively than the substances proposed in M. Schueller's patent.

The recent introduction by l'Oréal of Paris of pyrogallol in compressed tablets, which are dissolved in the liquid containing the metallic salt immediately before use, constitutes a useful improvement in the form of this class of dyes.

Under suitable circumstances, pyrogallol will combine with strong sulphuric acid to produce pyrogallol-sulphonic acid. According to a German invention, the alkaline salts of this substance are suitable for hair-dyeing and are said to be much less poisonous than pyrogallol itself. Various shades from blonde to dark brown, fast to soap and water, can be produced, the addition of an oxidant, as in the case of pyrogallol, hastening the development of the colour, and the use of an iron mordant * resulting in darker shades. The process was patented in this country in 1906 (British Patent, 1906, No. 11,876), but the patent was allowed to become void in 1910.

---

* See p. 58 for explanation of this term.

CHAPTER VII

SOME OTHER METALLIC DYES

A CONSIDERABLE number of the metals form black or highly coloured compounds with sulphur, insoluble in water, and, in some cases, in alkalies and dilute acids as well. This fact, it may be incidentally mentioned, is made great use of in analytical chemistry. It also forms the basis of the employment of many metallic salts as hair-dyes.

Instances have already been met with in preceding chapters of the use of metallic sulphides, and it will have been noticed that, speaking generally, there are three methods employed for producing these substances and depositing them on and in the hair.

In the first method, advantage is taken of the fact that the hair contains sulphur, the hair of some persons being much richer in this element than that of others. A simple solution of a soluble salt of the metal is employed, slow combination taking place between the metal and the sulphur of the hair, with the production of the desired colour. An example is afforded by the use of a solution of iron (ferrous) sulphate as a hair restorer.

In the second method, a solution of a soluble salt of the metal is employed, to which either sulphur itself, or a rather unstable substance rich in sulphur, such as sodium thiosulphate, is added, slow combination between the metal and the sulphur taking place, as, for example, in progressive dyes based on lead.

In the third method, of which one sort of instantaneous silver dyes provide the best illustration, two solutions are employed, one containing a soluble salt of the metal, the other an alkaline sulphide. The two solutions are applied to the hair one after the other, the insoluble sulphide being immediately formed by double decomposition.

The following table gives a list of the insoluble sulphides which have found application in hair-dyeing, together with their chemical formulæ and their colours when produced in an amorphous form by, for example, the method of double decomposition.

Sulphide.	Formula.	Colour.
Bismuth sulphide . . .	Bi_2S_3	Brownish black.
Cadmium sulphide . . .	CdS	Yellow.
Cobalt sulphide . . .	CoS	Black.*
Copper sulphide . . .	CuS	Brownish black.
Ferrous (iron) sulphide . .	FeS	Black.
Lead sulphide . . .	PbS	Black.
Mercuric sulphide . . .	HgS	Black.
Nickel sulphide . . .	NiS	Black.
Silver sulphide . . .	Ag_2S	Black.
Stannic (tin) sulphide . .	SnS_2	Yellow.

Copper sulphide has been included in the above table, but it is really quite useless to deposit this substance, as it rapidly undergoes oxidation in the air to form blue copper sulphate, which is soluble in water. Dyes based on mercury are distinctly dangerous, owing to the highly toxic character of the compounds of this metal, and are not used to-day. Tin is another toxic metal very little employed.

In passing, reference may be made to a formula for a two-solution dye, given by Askinson (*Perfumes and Cosmetics : their Preparation and Manufacture*) based on the reaction between copper salts and those of ferrocyanic acid, which, however, does not yield satisfactory results and whose constituents are of a rather objectionable nature.

BISMUTH DYES

Bismuth hair-dyes make use of the fact that bismuth sulphide can be obtained by interaction between a suitable bismuth salt and sodium thiosulphate, which latter substance is in every way much more agreeable to employ than any of the alkaline sulphides.

---

* A black polysulphide (Co_2S_7 ?) may also be formed in suitable circumstances.

These dyes, however, are by no means easy to prepare, and many of the published formulæ are useless. The difficulty arises from the fact that the ordinary salts of bismuth are either insoluble in water or are decomposed in dilute solution with the production of insoluble basic salts. Thus, for example, bismuth nitrate, which forms colourless crystals, having the chemical formula $Bi(NO_3)_3 . 5H_2O$, and containing about 43 per cent. of bismuth, can be dissolved in dilute nitric acid ; but on adding more water to the solution, a basic nitrate, $Bi(OH)_2NO_3$, called " bismuth sub-nitrate," is precipitated as a white powder. Bismuth chloride behaves in an analogous manner.

Various ways of surmounting the difficulty have been proposed.

Naquet's method (*vide* Cerbelaud's *Formulaire*) is as follows :—

One hundred grams of metallic bismuth are dissolved in the least possible quantity of ordinary nitric acid (about 280 grams). Seventy-five grams of tartaric acid dissolved in water are added, and the liquid is then diluted with a large amount of water, so large that on filtering a portion of the liquid and adding more water to the filtrate, no further precipitate is produced. The whole of the liquid is then filtered, and the precipitate is washed on the filter paper with water until it is free from acid. After it has been washed, the precipitate is dissolved in a sufficient quantity of ammonia, this being added to it little by little. Seventy-five grams of powdered sodium thiosulphate are dissolved in the solution, which is filtered and diluted with water to 2 litres. A little glycerine may be added. Used daily, this preparation is said to produce shades from blonde to dark brown, according to the number of applications.

The above, it will be noticed, is a one-solution dye. Cerbelaud also gives a formula for a two-solution dye, the bismuth solution being prepared by dissolving 50 grams of bismuth citrate in the following mixture :—

Spirits of wine	33 grams.
Rose-water	200 ,,
Distilled water	300 ,,

—by means of a sufficient quantity of ammonia. This is used in conjunction with a developing solution containing 120 grams of sodium thiosulphate dissolved in 400 grams of distilled water. He adds, however, that the formula " is sometimes difficult, if not impossible, to prepare."

Winter (*Handbuch der Gesamten Parfumerie und Kosmetik*), on the other hand, makes use of the fact that glycerine, if present in sufficient amount, prevents the decomposition of bismuth nitrate by water. His method is as follows : 100 grams of bismuth nitrate are placed in a measuring cylinder graduated up to 1,000 c.c., and 100 grams of pure glycerine are added. A solution of 100 grams of glycerine dissolved in water to make 1 litre is prepared, and gradually poured into the cylinder, dissolution of the crystals of bismuth nitrate being facilitated by crushing them with a glass rod having a flattened end. Addition of the solution of glycerine is stopped if a precipitate forms. With careful work, however, it is possible to add sufficient to make 1 litre of solution. This solution is used, in conjunction with a 20 per cent. solution of sodium thiosulphate in water, as a blonde dye.

It may be added that if bismuth sub-nitrate is ground up with mannitol, the resulting product is soluble in water. We can, however, find no record of this device being made use of for the preparation of bismuth hair-dyes.

Bismuth frequently contains arsenic, and it is essential, therefore, that only perfectly pure bismuth compounds should be employed. When pure, large quantities of the basic salts of bismuth can be taken internally without harm, and such compounds are much employed in medicine. When absorbed externally, however, bismuth possesses toxic properties, several serious cases of poisoning having occurred through the use of preparations containing bismuth in dressings for wounds. Hair-dyes based on bismuth, therefore, cannot be regarded as preferable on the score of harmlessness to those containing many other metals. Moreover, the continued use of bismuth dyes has been found to render the hair sticky, though whether this is due to the bismuth or to other ingredients we are not prepared to say.

The above details concerning bismuth dyes have been given mainly because of their theoretical interest. Actually, nowadays, these dyes are little if at all employed, at any rate as far as England and France are concerned.

CADMIUM DYES

In the case of cadmium, the best salt to employ is the sulphate, which forms white crystals, soluble in water, possessing the chemical formula $3CdSO_4 . 8H_2O$, and containing about 44 per cent. of cadmium. A 5 per cent. aqueous solution of this salt can be used with a second solution containing an alkaline sulphide; but the bright yellow colour of the resulting cadmium sulphide is a most unusual and inartistic one from the trichological point of view.

Cadmium, however, need not be used alone, and this remark applies to compounds of the metals generally. By using compounds of various metals in conjunction, a very large number of different shades and tones can be produced. Stitson, for example (*The Human Hair: its Care and Preservation*), has published a number of formulæ for silver dyes, in which small proportions of copper and lead salts are introduced to obviate a metallic appearance and to improve the tone of the resulting colour. The most useful salts for this purpose, however, are those of nickel and cobalt.

NICKEL AND COBALT DYES

The salts of nickel and cobalt most employed are nickel nitrate, $Ni(NO_3)_2 . 6H_2O$, containing about 20 per cent. of nickel; nickel sulphate (or nickel vitriol), $NiSO_4 . 7H_2O$, containing about 21 per cent. of nickel; and cobalt nitrate, $Co(NO_3)_2 . 6H_2O$, containing about 20 per cent. of cobalt. The first and second consist of green crystals, soluble in water to form green solutions; the last occurs in red crystals, dissolving in water to form a pink solution. Cobalt, it should be mentioned, frequently contains arsenic, so that a perfectly pure product must be insisted upon.

Any one of these salts, in an aqueous solution containing up to 5 per cent., may be employed as a hair-dye, the colour being developed by means of a second solution containing an alkaline sulphide.* Used in quantities such as these, cobalt and nickel are harmless. These salts can also be employed in conjunction with pyrogallol ; and, all things considered, cobalt and nickel can be correctly described as two of the most useful metals in the art of hair-dyeing.

As just indicated, one important use is to improve the tone and to enlarge the range of colours obtainable by means of silver. For this purpose, ammoniacal solutions are required, the colour being developed by a second solution containing from 1 to 4 per cent. of pyrogallol, according to the shade required. A third solution, containing an alkaline sulphide may also be employed, as in the case of simple silver dyes, for the production and fixing of the darkest shades.

Ammonia added to a solution of a nickel salt produces, at first, a greenish precipitate, which dissolves, when more ammonia is added, to form a violet-blue solution. In the case of cobalt, the precipitate first formed is blue in colour. This readily dissolves in more ammonia to form a golden brown solution, rapidly becoming red owing to absorption of oxygen from the air, with the production of a complex "cobaltammine" compound.

Readers desiring to experiment with mixed metallic dyes, or to employ them on any considerable scale, will find it a good plan to make up stock solutions containing a known weight of each salt in a known volume of solution. Ten grams of the salt in 1 litre of solution, or 10 per cent., is the most useful strength. By using these solutions, it is possible to obtain any required weight of the salt in grams by measuring out ten times the number of cubic centimetres of the solution. The stock solution of cobalt should be rendered ammoniacal at the time of making up ; in the case of nickel and silver, sufficient ammonia to dissolve the precipitate first formed can be added after mixing and before making the mixed solution up to the requisite volume. Pyrogallol solutions for developing the colour are best made up as required, as they do not keep well. The

---

* In the case of cobalt especially, it is desirable to follow this with a third solution containing a little pyrogallol (½ per cent.) to prevent oxidation of the pigment.

solution of the metallic salts is applied to the hair first; the pyrogallol solution afterwards.

A magnificent black can be obtained by using the following formula, the colour being developed by means of a second solution containing 4 per cent. of pyrogallol dissolved in water:—

Silver nitrate	3·5 grams.
Cobalt nitrate	1·5 ,,
Nickel nitrate	3·0 ,,
Ammonia, 0·880	*q.s.*
Water	to 100 c.c.

We recommend readers, however, not to work by rule of thumb, but, grasping the general principles, to experiment for themselves. By reducing the total proportion of metallic salts, and using weaker solutions of pyrogallol, lighter shades can, of course, be obtained. What is, however, especially important is that by increasing the amount of cobalt nitrate at the expense of the silver and nickel salts, a warm note can be introduced and the rather unpleasant ash effect of the silver overcome. To illustrate: all three formulæ below produce excellent chestnuts, a colour unobtainable by means of silver alone, No. 1 being a rather dark chestnut, No. 3 a rather light one:—

	No. 1.	No. 2.	No. 3.
Silver nitrate	1·0 gram.	0·5 gram.	*Nil.*
Cobalt nitrate	5·0 grams.	5·0 grams.	5·0 grams.
Nickel nitrate	*Nil.*	0·5 gram.	1·0 gram.
Ammonia, 0·880	*q.s.*	*q.s.*	*q.s.*
Water	to 100 c.c. in each case.		

The colour is developed by means of a second solution containing 3 grams of pyrogallol dissolved in water to make 100 c.c.

Winter has published some interesting formulæ for dyes containing cobalt and nickel prepared along the lines of Schueller's patent mentioned in the last chapter, which we find on testing yield the colours stated. Put in a tabulated form, these are as under :—

	Ash blonde Parts by weight.	Chestnut Parts by weight.	Dark brown Parts by weight.	Black Parts by weight.
Pyrogallol	2	2	2	2·5
Sodium sulphite	4	4	4	5
Cobalt nitrate	1	5	10	*Nil.*
Nickel nitrate	*Nil.*	*Nil.*	*Nil.*	10
Ferric chloride	*Nil.*	*Nil.*	*Nil.*	5
Water	100	100	100	100

One-solution progressive dyes can be prepared by using silver nitrate and other suitable compounds in ammoniacal solution. The following formula for a black dye of this character is taken from Jouhar's *Beauty Secrets and Recipes* :—

Nickel sulphate	1 part
Silver nitrate	15 parts
Ammonia, 0·880	*q.s.*
Distilled water	320 parts.

Dyes of this character require to be left in contact with the hair for long periods, and are not very satisfactory in their action.

POTASSIUM PERMANGANATE

Finally we come to potassium permanganate ($KMnO_4$), which is a metallic dye entirely different in character from those already dealt with, and a substance too well known to stand in any need of description. Potassium permanganate readily oxidises organic matter, at the same time depositing a dark brown oxide of manganese, which metal somewhat resembles iron. A simple solution of permanganate in water may be used as a brown hair-dye, and some very lovely shades of golden brown can be obtained by means of its aid, though they are apt to prove rather impermanent.

Permanganate can be classed as a harmless dye, suited to home usage. No toxic effects need be feared, providing only weak solutions are employed, though, of course, over use of so strong an oxidant may prove deleterious to the hair itself. The strongest solution which can be made with cold water contains only just over 5 per cent. of the substance, and will dye some hair almost black. In spite of this fact, certain of the formulæ which have been published prescribe larger proportions. They could only be made by using hot water, and the solutions would deposit the excess on cooling. Actually for most hair-dyeing purposes, very weak solutions will be found all that is necessary. The best way to arrive at the requisite strength is not to work by means of any rule of thumb, but to test the solution on a small lock of the hair, cut preferably from behind the ear, and defatted with soap and water or a solution of borax.

In applying permanganate, care should be taken to keep it from the skin, which otherwise becomes stained. If stains should accidentally be made, these can be readily removed by means of a solution of sodium thiosulphate acidulated with a few drops of sulphuric acid* ; or a weak solution of sulphur*ous* acid may be employed.

Owing to its oxidising action on the pigments of the hair, permanganate can be employed as a hair-bleach. We do not recommend it for this purpose, for which, generally speaking, it is much inferior to hydrogen peroxide ; but it is sometimes found useful when snow-white hair is desired. The hair, after treatment with a 5 per cent. solution of potassium permanganate, is thoroughly washed, and then treated with a 10 per cent. solution of sodium thiosulphate, freshly prepared and acidulated with 2 per cent. of concentrated sulphuric acid. This latter solution dissolves the manganese dioxide deposited by the permanganate and leaves the hair bleached. Two or more applications may be necessary.

Some authorities prefer sodium permanganate to the potassium salt. The action of the two substances is similar.

---

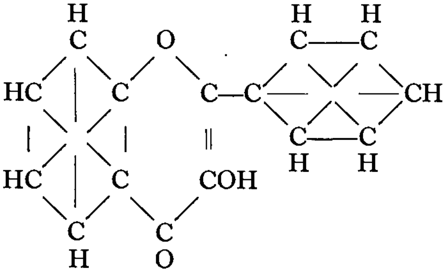
* See caution on p. 23.

CHAPTER VIII

DYES FOR POSTICHE

HAVING considered in previous chapters the various metallic substances used for dyeing the hair, we now pass to a consideration of vegetable dyes. Of the very many dyes obtained from the vegetable kingdom and extensively used in the past for the dyeing of textiles, most have been superseded for that purpose by the use of coal-tar products. Certain of these vegetable dyes, however, can be very usefully employed for the dyeing of cut hair, etc., for postiche purposes, the most important members of this group being Fustic, Quercitron, Catechu and Logwood. So far as living hair is concerned, these dyes appear to be relatively little employed, owing to difficulties of application, though M. Schueller's patent, referred to in Chapter VI., mentions hæmatoxylin (present in logwood) and allied substances as suitable for use in his method, and catechu is sometimes used in conjunction with henna.

The tinctorial principles contained in the first two of the above natural dyes, it is interesting to note, have been found, from a chemical point of view, to be derivatives of a substance called " flavonol "—



Flavonol.

—from which and from the closely related flavone, many of the yellow colours met with in Nature are derived. The colouring matters in logwood and Brazil wood are substances possessing a rather similar chemical structure, whilst the chemical constitution of catechin, the colouring matter of catechu, is also nearly related to that of the flavonols.

RÔLE OF MORDANTS

The technology of dyeing fabrics is much better advanced than that of hair-dyeing, and the action of certain substances called " mordants," whose part is very important, is well understood. Some dyes do not need their aid, and are known as " substantive dyes." When a fabric is steeped in a solution of a substantive dye, a chemical combination takes place between the substance of the fabric and the dye, with the result that the fabric becomes coloured and the colour is not removed by subsequent washing.

In the case of other dyes, a fabric steeped in a plain solution of the dye merely becomes tinted and the colour washes out. In such cases, a mordant has to be employed, a substance which will combine with the dye and fix it, in an insoluble state, on the fabric, the action being a form of double decomposition. The substances most commonly employed for this purpose are salts of aluminium, iron and tin, and potassium dichromate. Mordants are more frequently required for dyeing cotton than in the case of dyeing materials of animal origin, such as wool and (natural) silk ; but some dyes require them for all fabrics. Logwood, for example, is an adjective dye, always requiring a mordant, and giving different colours with different mordants. The mordants are applied in various ways, for example, when wool is dyed with logwood, the wool may be steeped in separate solutions of dye and mordant, either being used first, or in a bath containing both mixed together.

In the case of hair, mordants are required with all the dyes mentioned in the opening paragraph of this chapter, the two most commonly used being alum and ferrous sulphate, of which the latter yields darker shades than the former. The usual method of effecting the dyeing, which will be described in detail in Chapter IX. of Part III., is to immerse the hair in a boiling solution containing both the dye and the mordant. Tannin is also sometimes added. Not only does this substance help to fix the colour ; but, when an iron mordant is used, it acts itself as an adjective dye, producing a purple-black ground colour.

With these preliminary remarks we now pass to a detailed consideration of the dyes in question.

VEGETABLE DYES

FUSTIC is the wood of *Chlorophora tinctoria*, a tree, belonging to the nettle family, indigenous to America. Its tinctorial powers are due to the presence in it of morin, a tetra-hydroxy derivative of flavonol. With alum, fustic dyes deep yellow ; with iron or copper, it gives olive shades. It is employed in conjunction with logwood. Fustic, by the way, is often called " Old Fustic " to distinguish it from " Young Fustic," an entirely different natural dyestuff.

QUERCITRON consists of the inner bark of a species of oak, *Quercus tinctoria*, native to North America. It contains quercetin, another tetra-hydroxy flavonol, and quercitrin, a compound of this substance with rhamnose (a sugar), which is easily decomposed. It gives shades rather similar to those produced by fustic, and, like this dye, may be usefully employed for modifying logwood blacks.

Quercetin, as well as tannin, also occurs in certain parts of the horse chestnut (*Æsculus Hippocastanum*), extracts of which were at one time used in dyeing postiche.

Catechin and catechu-tannic acid occur together in CATECHU, also known as " pale catechu " or " gambier." Black catechu, or cutch, also contains catechu-tannic acid as well as a substance resembling catechin. The former is extracted from *Uncaria Gambier*, a climbing shrub indigenous to the Malay Archipelago, and allied species. The latter is extracted from various species of *Acacia* or *Mimosa*. Catechin dyes pale yellow with alum and brown with an iron mordant.

LOGWOOD, the heart-wood of *Hæmatoxylon campechianum*, a tree growing in Central America and the West Indies, contains two important substances, hæmatein and hæmatoxylin. The former can be obtained in reddish coloured crystals with a green metallic lustre. The latter is colourless; it is the "leuco-compound" corresponding to the dye, hæmatein, into which it is converted on oxidation, the term "leuco-compound," as explained on p. 16, being applied generally to colourless bodies which combine with oxygen to give dyes. Logwood is a most valuable dye for the production of black (iron mordant) and ash shades (alum mordant), as well as for modifying the colours produced by the previously mentioned dyes. Of all the dyes under consideration, it is found to be the one most generally useful.

BRAZIL WOOD, another dye of the same class, consists of chips of the wood of several species of leguminous trees which grow in the tropics. Like logwood, it contains a dyestuff proper, brazilein and a leuco-compound, brazilin, which is converted into the dyestuff on oxidation. Brazil wood dyes red when mordanted with alum; but the colour is apt to prove fugitive, and this dye, therefore, is not much employed.

SHADES AND FORMULÆ

Catechu is more or less completely soluble in boiling water. In the case of the other dyes, the tinctorial principles can be extracted by boiling with water; and it will be found convenient to prepare strong extracts of each, which can be stored for use as may be required. These extracts can be prepared by putting 1 part by weight of the chips, broken up as small as possible, in 10 parts of water contained in an enamelled saucepan,* allowing the liquid to simmer until it is reduced in bulk to one-half and straining it off. It has been recommended to add one-tenth per cent. of carbolic acid to extracts which it is proposed to store; but many of the fragrant essential oils used in perfumery are not only quite as efficient but pleasanter to use.

None of these dyes, with the exception of logwood, can be successfully employed alone. The yellows which fustic, catechu and quercitron give with alum are too bright, and the

---

* It is important that the enamel is free from cracks, as otherwise the dye may react with the exposed metal.

browns produced with iron are of an olive tone, very unlike the natural colour of brown hair. The addition of logwood, however, corrects these defects. And whilst logwood can be used alone for ash shades and black, the addition of a proportion of a brown dye prevents the possible development of purple or blue tones.

Considerable skill is called for in manipulating these dyes to obtain the correct effects. Many of the formulæ which have been published are completely worthless. The recipes which we give below have been tested, and found to answer satisfactorily. We offer them, however, not as formulæ to be slavishly adhered to, but as illustrative of the general principles which must be followed in using these dyes.

A good ash dye can be prepared from catechu and tannin, using an iron mordant, as under:—

Catechu	60 grams.
Tannin	20 ,,
·Ferrous sulphate . . .	30 ,,
Water . . . . to	1 litre.

This is useful for converting light brown hair into dark brown or black according to the length of time the hair is immersed in the boiling dye solution.

For a more intense black, logwood, mordanted with iron, may be employed, the introduction of fustic improving the quality of the colour. The following formula may be used:—

Logwood extract . . .	400 c.c.
Fustic extract	200 ,,
Ferrous sulphate . . .	20 grams.
Water . . . . to	1 litre.

For the production of lighter shades, logwood and quercitron, mordanted with alum, may be used. We give two formulæ below:—

	A.	B.
Logwood extract .	200 c.c. ...	250 c.c.
Quercitron extract .	300 ,, ...	250 ,,
Alum . . .	30 grams. ...	30 grams.
Water . . .	to 1 litre in each case.	

Formula A is useful for slightly darkening light brown hair without loss of brightness. Formula B produces a more marked effect. Both may be used on grey hair, though actually grey hair is rarely dyed for postiche purposes. If so employed, formula B, which gives a nice light brown, is the better, as that produced by formula A is rather too yellowish in tone.

SOME OTHER DYES FOR POSTICHE

Some hairdressers favour the use of pyrogallol for darkening the colour of faded blonde and brown switches and for dyeing bleached hair. A stock solution may be prepared as follows:—

Pyrogallol	20 grams.
Methylated spirits	30 c.c.
Concentrated hydrochloric acid	1 ,,
Distilled water	to 1 litre.

and used with boiling water in varying proportions as required. The solution, however, does not keep very well.

Blue-black writing ink is another preparation employed, diluted with water as may be required. This fluid consists essentially of a solution of gall-nuts plus ferrous sulphate, the formation of the colouring matter being held up by the addition of a trace of sulphuric acid, and the liquid being coloured blue with indigo, so as to make it easily visible when words are written with it. Paper contains traces of ingredients which neutralise the acid, and the oxygen of the air converts the iron from the ferrous into the ferric state, with the production of the black, insoluble compounds which tannic and gallic acids produce with ferric salts. A similar reaction takes place when hair is dyed by means of ink, ink it will be seen, being made on rather similar lines to the liquid rasticks mentioned on p. 47, in which an acid is added to hold up the reaction between the metallic salts and the pyrogallol.

CHAPTER IX

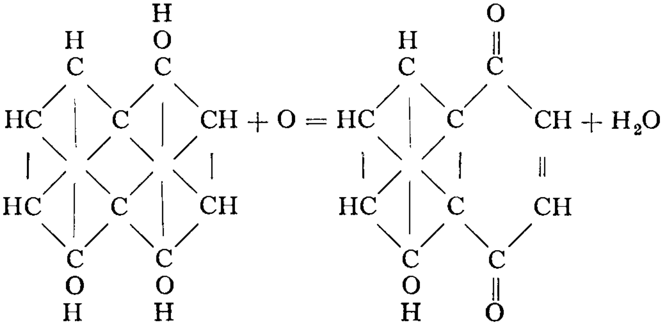
WALNUT EXTRACT

THE common walnut tree, *Juglans regia*, and its fruit are too well known to stand in need of any description. The tree is classified by some botanists as a member of the natural order *Amentaceæ*, and is thus related to the Birch, Alder, Hazel, Oak, Sweet Chestnut, etc. It is not a native of Britain, but is cultivated in this country both for its timber and for its fruit. It is also well known that the green husks of the fruits contain a substance which stains the hands brown, the colour proving very resistant to soap and water.

THE CHEMISTRY OF WALNUT—JUGLONE

The colouring matter is known as juglone, or, to give it its full scientific name, 5-hydroxy-1, 4-naphthaquinone, and is a yellow, crystalline substance, which is produced from the walnut juice in the following manner :—

The walnut husks contain two isomeric * substances, one of which, distinguished as 1, 4, 5-hydroxy-naphthalene, or *alpha*-hydrojuglone, rapidly undergoes oxidation on exposure to the air, with the production of juglone. The reaction is represented thus :—



alpha-Hydrojuglone Juglone

---

* Two substances are said to be "isomeric" when their molecules contain the same number and sort of atoms, differently arranged.

The other kindred body, called *beta*-hydrojuglone, it is interesting to note, does not undergo any corresponding change.

Walnut extract is an old-fashioned hair-dye, of a quite harmless character, and is employed alone and, sometimes, in combination with henna. However, in spite of the fact that the action of walnut juice on the skin would seem to show there to be a great chemical affinity between juglone and keratin, walnut extract has not proved satisfactory as a hair-dye. It is, perhaps, a substance which would repay further and more detailed investigation with the purpose of hair-dyeing in view.

PREPARATION OF WALNUT EXTRACT

The extract can be obtained by macerating the green husks with hot water, water mixed with alcohol, or alcohol alone. According to one recipe, the crushed husks are covered with water containing 1 per cent. of common salt and allowed to soak for three days. The husks and liquid are then transferred to a suitable vessel and maintained at a temperature just below the boiling-point for about five hours, fresh water being added from time to time to make up for that lost by evaporation. All liquid is squeezed from the mass, either by means of a press or by twisting it in a cloth, and the separated liquid is then evaporated to a quarter of its bulk and diluted with 90 per cent. alcohol, previously perfumed, in the proportion of 1 part of alcohol to each 6 parts of extract.

According to another method, 15 parts by weight of the husks, together with 1 part of alum, are pounded in a mortar with 4 parts of water. After standing for a couple of days, 90 per cent. alcohol is added in the proportion of 3 parts of spirit to 10 parts of liquid. The mass is well mixed, allowed to stand another four days in a closed vessel, and the liquid then squeezed out.

METHOD OF APPLICATION

The big problem in connection with hair-dyeing by means of walnut extract is that of fixing the dye. Durvelle refers to the alum, which is usually added in making the extract, merely as a preservative ; but Askinson speaks of it as fixing the colour, its *rôle*, as in other applications, being that of a mordant.

Winter describes walnut extract, from a practical point of view, as being " absolutely worthless."

Before applying walnut extract, the hair must be freed from grease by means of shampooing, and great care must be exercised in applying the dye to keep it from coming into contact with the scalp, which otherwise becomes stained, the effect being unsightly.

Hair freshly dyed with walnut extract looks rather yellowish, but the full, warm brown colour develops in the course of a few days.

Hair oils, prepared by macerating the green husks in olive oil, a little alum being added, and also pomades, are forms in which this dye has also been employed. Dr. Max Joseph recommended these preparations and gave formulæ for making them in his *Short Handbook of Cosmetics*, which have been reproduced in Dr. Hubbard's recently published *Treatise on Diseases of the Hair*. Dr. Koller's well-known work on *Cosmetics* also contains formulæ. But, nowadays, these preparations are rarely, if ever, employed.

TESTING FOR SILVER AND COPPER

Walnut extract does not keep very well, and is at its best when freshly prepared. Some proprietary dyes sold as walnut extract contain copper compounds, whilst others have been found to be silver dyes containing no extract of walnut whatever.

As the detection of silver and copper in hair-dyes is such a simple matter, a description of the method is appended :—

Evaporate a little of the dye to dryness in a porcelain dish. Add a few drops of concentrated nitric acid, and heat strongly to destroy all organic matter. If there is any residue left after this treatment, dissolve it in a little *distilled* water with the addition of a drop or two of nitric acid, pour the solution into a test-tube, or small bottle, and test it by adding, first, a little hydrochloric acid, and then ammonia solution until the liquid smells strongly of the latter reagent, shaking the tube or bottle well after each addition. If the liquid goes milky on adding the hydrochloric acid, but clears when the ammonia solution is poured in, silver is present, the milkiness being due to the formation of silver chloride, which will not dissolve in water or acids, but is soluble in ammonia. If the ammonia causes, first, a greenish blue cloudiness, which, as more ammonia is added, clears, giving a rich blue-coloured liquid, copper is present. The development of the blue colour, due to the formation of a complicated compound known as a cuprammonium salt, is a very delicate test, serving to detect small traces of copper. The rather similar reaction given by nickel *may* be mistaken for it, and if the presence of this latter metal is suspected, more elaborate tests may be necessary.

CHAPTER X

HENNA

In the East, henna is extensively used as a hair-dye, alone to produce a brilliant auburn shade, followed by an application of a preparation of indigo to dye the hair black. From the East, henna has come to the Western world. According to Mr. E. M. Holmes,* its use in Northern Europe dates from 1890, " when a secret hair-dye containing it to produce auburn-coloured hair was made fashionable by Madame Patti and others in Paris." From Paris, the use of henna spread rapidly to England ; and henna has found great favour, especially for the reason that, unlike some of the substances employed as hair-dyes, it is perfectly harmless to both hair and skin.

THE HENNA PLANT

Henna is obtained by powdering the dried leaves and young twigs of the Egyptian privet. To botanists this shrub is known as *Lawsonia alba*, *Lawsonia spinosa* and *Lawsonia inermis*, the latter names having been given to it in the belief that there were two different species, one with, and one without, spines. In all probability, however, the spines are simply the result of age.

The shrub, which normally grows to a height of 6 feet or more, appears to be indigenous to Arabia and the surrounding districts, both Asiatic and African, and is widely cultivated in tropical countries. Its nearest British relative is the purple loosestrife (*Lythrum salicaria*), which grows plentifully along river banks in England, and is one of the few plants native to Britain belonging to the natural order *Lythraceæ*, of which *Lawsonia* is a member. Like purple loosestrife, henna shrubs thrive in a damp soil ; and in Tripoli, where there are many henna plantations, these are kept constantly under irrigation.

Lawsonia alba bears small, greenish white and very fragrant

---

* *Pharmaceutical Journal* (1924), Vol. 112, p. 437.

flowers, with which Eastern women adorn themselves, and from which a perfume is obtained by means of distillation with water. The Hebrew word " copher " almost certainly refers to henna, and is so translated in the Revised Version of the Bible: thus, in *The Song of Songs*, i. 14, Solomon compares his beloved to " a cluster of henna-flowers."

When, however, the plant is cultivated for henna, it is not allowed to flower, but is cut down to promote the development of the leaves. In Egypt and the Soudan, the plants are cut down when they are about 3 feet high. Fresh shoots soon appear, several crops being obtained in successive years. In Tripoli the plants are cut down twice a year, about the end of February and the end of August, whilst on the Indian plantations the plants are cut two months later, only the top portions being removed.

Naturally, the quality of henna depends a great deal on the care with which the plants are cultivated and the manner in which the powder is prepared and sifted. The colouring matter occurs to a much less extent in the twigs than that to which it does in the leaves. The addition of the twigs, therefore, is inadvisible, and is avoided in preparing the best qualities. Moreover, apart from substances sometimes added to improve its effectiveness as a dye, henna is subject to heavy adulteration, various worthless vegetable products, whose presence it is not always easy to detect, as well as sand, being used for this purpose. It should not be necessary to warn readers, therefore, of the advisibility of purchasing supplies of henna powder only from reputable firms who give a guarantee of the purity of the article.

THE CHEMISTRY OF HENNA—LAWSONE

The colouring matter of henna can be extracted from it by means of hot water, of which property use is made in the practical application of henna as a hair-dye. It is also soluble in glycerine, solutions of ammonia and other alkalies, and dilute acids; but is very slightly soluble in alcohol, chloroform or ether. The colour of the aqueous extract is intensified by the addition of ammonia and other alkalies, whilst strong acids have the reverse effect upon it.

PLATE II.

FIG. 5.—A HENNA PLANTATION.
(*Block kindly lent by the Evan Williams Co., Ltd.*)

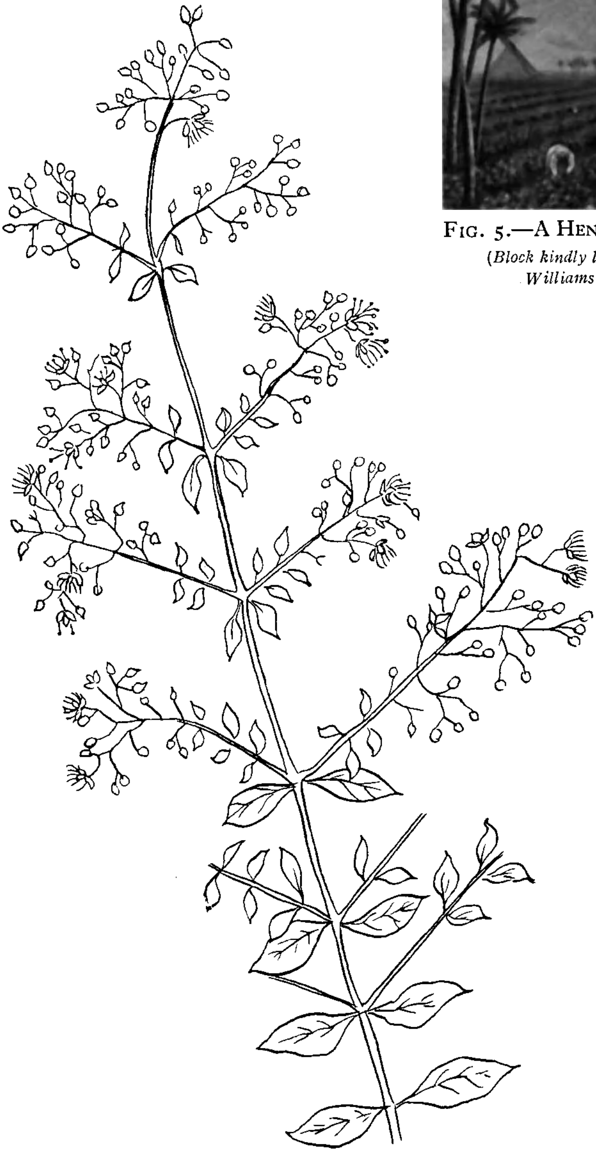


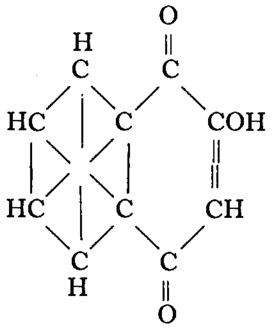
FIG. 4.—THE HENNA PLANT (*Lawsonia alba*) in bloom.

[*To face p.* 68.

In 1863, Herraory obtained the colouring matter in an impure form as a gum, brown in colour, soluble in water, and blackened by the addition of ferric chloride, which facts caused him to regard it as " a kind of tannin."

In spite of the great interest taken in natural colouring matters by dye chemists and the many researches carried out on other natural dyes, henna, for some inexplicable reason, appears for many years to have escaped attention, and it was not until the publication of Tommasi's first paper in an Italian scientific journal in 1916, that anything further seems to have been done towards elucidating the question of the chemical composition of henna. Since that date, however, our knowledge of the subject has been considerably enriched by the work of the chemist just mentioned, who has not only carried out analyses of the leaves and branches of *Lawsonia alba*, but has succeeded in extracting the pure colouring matter in the form of orange-yellow, needle-like crystals, 2 grams being obtained from 1,000 grams of dried leaves.

This crystalline pigment has been christened " lawsone," and its properties have been investigated by Tommasi.* It is fixed well by wool and silk, even without a mordant, and rapidly and tenaciously by the skin. Its chemical composition corresponds to the formula $C_{10}H_6O_3$; and, from its chemical behaviour, Tommasi concludes that it is probably 2-hydroxy-1, 4-naphthaquinone, whose structural formula is :—



---

* For full details see his paper published in *Gazz. chim. ital.* (1920), Vol. 50 (1), p. 263.

Lawsone, therefore, it is interesting to note, is related to juglone, the colouring matter derived from walnut husks, being, in fact, isomeric with this substance.

The statement in the eleventh edition of the *Encyclopædia Britannica* that henna contains no tannin is incorrect. The amount of tannin present, however, as found by Tommasi and other investigators, is, in the case of henna leaves, under 1 per cent. From Tommasi's experiments it would appear that tannin has no action on lawsone, so that no justification would seem to exist for adding tannin to henna for use as a hair-dye, although this is sometimes done.

The tenaciousness of henna as a dye when applied to skin, hair or nails, and the fact that the colour is not affected by washing, indicates that chemical combination takes place between the keratin and the lawsone with the production of a red substance. To this fact, henna owes its superiority as a hair-dye to those preparations which merely deposit a pigment on the hair.

A process for extracting the dye-stuff from henna has been patented in Great Britain—see Patent No. 236,557 (July, 1924).

HENNA SHAMPOOS

Nowadays, in the Western world, henna is used very extensively, (i.) in small quantities in shampoos to brighten the hair, (ii.) by itself as a hair-dye to produce a red colour, and (iii.) mixed with various other substances to dye the hair various shades.

Henna shampoos can be prepared by mixing henna powder with suitable cleansing agents and adding a small quantity of perfume, the proportion of henna varying from 5 to 10 per cent. or more of the total amount of material. As cleansing agents, mixtures of borax, sodium carbonate, potassium carbonate, soap powder and saponine, are usually employed ; and for perfuming, patchouli and other essential oils or synthetics are added. The following is a typical formula, permitting of many variations :—

Henna powder	10 parts.
Soap powder	40 ,,

Sodium carbonate dry	25 parts.
Borax	15 ,,
Potassium carbonate	5 ,,
Saponine	4 ,,
Perfume	1 part.

For liquid henna shampoos, the henna is infused in about ten times its weight of boiling water. After filtration, the infusion is mixed with an alcoholic solution of soap, perfumed, and diluted with water to about ten times its original bulk.

HENNA DYES

In order to dye the hair by means of henna, whether used alone or mixed with other ingredients, the material has to be applied in the form of a pack, a very special technique being required, which is fully explained and illustrated in the chapter on "The Technique of Henna Dyeing," in Part III. When used alone, henna produces only auburn. It is, therefore, generally employed in combination with other dyes. These "compound hennas" will be considered in the next chapter. It may, however, here be added that of the many such preparations now on the market, some would appear to owe their efficacy as dyes mainly to the other ingredients; and there is an unfortunate and misleading tendency to use the word "henna," because of the known harmlessness of the substance and the fact that its action on the texture of the hair is, if anything, positively beneficial, as a euphemism for "hair-dye." *

---

* Some so-called "hennas" contain the dangerous dye, paraphenylene diamine.

CHAPTER XI

HENNA-RENG, AND OTHER COMPOUND HENNAS

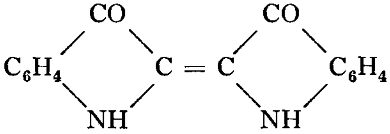
As explained in the previous chapter, henna, used alone, is capable of dyeing the hair only one colour—namely, auburn. It is, therefore, usually employed in conjunction with other dyes, these mixtures being known as " compound hennas." The most important is " henna-reng," a combination of henna with powdered indigo leaves, which is much employed in Persia and elsewhere in the East to dye the hair and beard a magnificent blue-black.

INDIGO

Indigo has been known and valued as a dye from the earliest times ; and it was with a preparation of this substance that the early inhabitants of these islands dyed their bodies instead of clothing them.

Indigo-yielding substances occur in the leaves of a number of plants, including Woad (*Isatis tinctoria*) and especially several species of *Indigoferæ*, plants belonging to the natural order *Leguminosæ*, or pea family. These latter contain a peculiar glucoside or sugar-compound, called " indican," which undergoes fermentation and oxidation when the powdered leaves are mixed with warm water and exposed to the air, indigo being deposited as an insoluble powder.

Indigo-blue, the colouring matter of indigo, is known to chemists as indigotin. Its chemical constitution is represented by the formula below :—



Indigotin.

Commercial indigo contains from 20 to 90 per cent. of indigotin, which substance is also synthetically prepared by a number of different processes.

Indigotin is a dark blue powder with a reddish glimmer. It is insoluble in all the usual solvents, such as water and alcohol; but dissolves in concentrated sulphuric acid to yield a compound which is decomposed by water. On reduction, it yields a leuco-compound, indigo-white, soluble in alcohol and alkalies. This body is easily oxidised to indigo-blue, a fact made use of in the dyeing of textiles.

HENNA-RENG

Indigo leaves alone are useless for hair-dyeing, owing to the lack of chemical affinity between indigo and the keratin of the hair. They must be used in combination with henna.

For this purpose, experience has proved that the leaves, dried and powdered, of *Indigofera argentea* (" reng "), cultivated in Persia, constitute the best form in which to employ indigo. Durvelle (*The Preparation of Perfumes and Cosmetics*) recommends a mixture of 80 grams of indigo leaves and 40 grams of henna for a light shade of brown, and 90 grams of indigo leaves and 30 grams of henna for dark brown to black. But too much reliance must not be placed on rule of thumb formulæ, as samples of indigo leaves vary very much in quality. Preliminary experimentation with each sample is desirable.

The method of application follows the line laid down in the chapter on " The Technique of Henna Dyeing," the indican fermenting during the operation with the production of the indigo. As already indicated, henna-reng dyeing is very successfully employed in countries enjoying a very warm and moist climate, the colours obtained excellently imitating Nature. But in colder countries, such as England, dyeing with henna-reng is a difficult and lengthy process. Were it not for this fact, henna-reng might be described as the most satisfactory preparation known for dyeing the hair various shades.

SOME OTHER COMPOUND HENNAS

Other vegetable dyes, besides indigo leaves, can be used in combination with henna. The addition of catechu and dried lucerne leaves, for example, has been recommended to produce darker shades than are given by henna alone; whilst powdered

Turkey rhubarb * may be added, in the proportion of 3 parts of rhubarb to 8 of henna, to produce a blonde dye.

The following formula for a compound henna, in which gall-nuts and a salt of iron are used, and which constitutes a perfectly innocuous dye, is given by Dr. Gastou (*Formulaire cosmétique et esthétique*) :—

Ferrous sulphate (powdered) . .	30 grams.
Gall-nuts (powdered) . . .	30 ,,
Henna (powdered) . . .	60 ,,

The hair is first shampooed. The powder is made into a paste with warm water, applied to the hair in the manner described in the chapter on " The Technique of Henna Dyeing," and left in contact with it for twenty-five minutes to two hours, according to the colour required. The hair is finally washed with tepid water.

We note with interest that the compound hennas manufactured by Messrs. M. Broux & Cie. of Paris, are stated to be absolutely vegetable in character, and are certified by the Paris Municipal Chemical Laboratory to be free from poisonous metals, alkaloids, phenols, amino-phenols, and other noxious bodies specified in the appendix to the Decree of September 14th, 1916.

HENNA-RASTICKS

Compound hennas can also be prepared by combining henna with dyes of the rastick type. These dyes are much employed and give a wide range of shades.

The following table for preparing them has been given by Chaplet :—

	Light brown.	Brown.	Dark brown.	Black.
Henna powder .	100	100	100	100
Pyrogallol . .	5	5	10	15
Copper sulphate .	5	7	8	10
Sienna . .	5	5	10	10
Lamp-black .	*Nil.*	1	5	20

---

* The tinctorial principle in this product, which consists of the dried roots of *Rheum palmatum*, is chrysophanic acid, a yellow dye.

Proprietory hennas are usually put up in six main shades: blonde, light brown, mid-brown, brown, dark brown and black. There are a large number of these on the market, and analyses which have been published show that many are based on the above or similar formulæ. The question whether they can be considered as harmless or not is one of great importance. M. Schueller (*De l'innocuité des teintures pour cheveux*) has put forward evidence for regarding copper as a far less toxic metal than it is generally considered. We are inclined to concur. The question of the harmlessness of pyrogallol is more debatable, and the conflicting views of experts are referred to in Chapter V. of this Part. M. Schueller regards henna-rasticks containing not more than 9 or 10 per cent. of this substance as harmless.

Speaking generally, dyeing with henna-rasticks is simpler than dyeing with henna-reng. Hair so dyed, however, can be permanently waved only with considerable difficulty.

CHAPTER XII

CHAMOMILE

THE inclusion of chamomile (or camomile) in a list of substances used for dyeing the hair might be criticised on the grounds that chamomile is not a dye. However, inasmuch as its use has a definite effect on the colour of the hair, it may rightfully be regarded as a hair-dye ; and one may add that its peculiar virtue, which is that of a " colour-tonic " for fair hair, is due to the very feebleness of its tinctorial powers, which, nevertheless, are real.

As a drug, chamomile has been in use for centuries. It was known to the Greeks as " anthemis," being employed by them medicinally ; and an old Saxon herbal mentions it as a remedy for sore eyes. The dried flower-heads of the cultivated plant are official in the British Pharmacopœia under the name of " Anthemidis Flores," as is also the oil (" Oleum Anthemidis ") obtained by distilling these with water, and which is used in medicine as a stomachic and carminative.

THE CHAMOMILE PLANT

The chamomile plant is known to botanists as *Anthemis nobilis*. It is a composite, whose white and yellow flower-heads resemble those of the daisy, but are considerably larger. When cultivated, however, the appearance of the heads undergoes a change, all the florets becoming white.

Chamomile is a low-growing, perennial herb, with a trailing stem about a foot long. Its leaves are much cut up, or, to speak botanically, are bipinnate, the segments being fine and short. The plant blooms in July to September.

Chamomile is cultivated on the Continent, especially in Belgium. Large quantities used to be grown at Mitcham, Surrey, but this is the case no longer. It is, however, still cultivated in England, at Long Melford, Suffolk, by Messrs.

PLATE III.

FIG. 6.—A FIELD OF ENGLISH CHAMOMILE on the farms of Stafford Allen & Sons, Ltd., Long Melford.

[*To face p.* 76.

PLATE IV.

Fig. 7.—Chamomile
(*Athemis nobilis*) wild form.

[*To face p.* 77.

Stafford, Allen & Sons, Ltd., who also distil the essential oil. A field of the plant of the Long Melford farms is shown in the illustration (Fig. 6).

Chamomile is probably indigenous to Western Europe, and although it cannot be correctly described as a common British wild flower, it occurs abundantly in many places in England, including some near London. Indeed, a few years ago, one of us actually found it growing wild in London itself, on playing fields near Wandsworth Common, and possibly it is still there. It favours turfy places, especially on a sandy soil.

" ROMAN " AND " GERMAN " CHAMOMILE

The botanical tyro may easily confuse *Anthemis nobilis* with four other native plants, which more or less closely resemble it, and which are all plentifully distributed. These are :—

(i.) *Anthemis arvensis* (Corn Chamomile).
(ii.) *Anthemis Cotula* (Stinking Chamomile).
(iii.) *Matricaria inodora* (Scentless Mayweed).
(iv.) *Matricaria Chamomilla* (Wild, or German, Chamomile).

Of these herbs, the scentless mayweed, a very common plant, is, as indicated by its name, without scent ; stinking chamomile has an unpleasant odour ; whilst the two other plants have odours resembling that of chamomile, but fainter, corn chamomile, indeed, being almost odourless.

Apart from the odour, which is not a very safe guide, chamomile can be easily distinguished by the following characters. If the flowers are removed from the head, little scales will be seen in the case of all species of *Anthemis ;* but these are entirely absent in *Marticaria*. Further, the scales of chamomile are oblong and more or less rounded at the top, whereas corn chamomile has narrow, pointed scales, and stinking chamomile still finer ones, resembling little bristles. The test is applicable to the dried flower-heads, and may be used to detect adulteration. This is important, because *Matricaria Chamomilla* is chamomile in Germany. An oil is distilled from this latter plant, which somewhat resembles true chamomile oil. It is known as " German Chamomile Oil," the true chamomile oil being sometimes distinguished as "Roman Chamomile Oil."

Other features which assist one in recognising *Anthemis nobilis*, when growing wild, are its procumbent habit, the *downy* character of its foliage, and the solitary flower-heads on long stalks. Fig. 7 shows a sketch of a plant from Littleworth Common, Surrey, where it grows wild.

With reference to German chamomile, of which a sketch of a plant from the same place is shown in Fig. 8, it may be added that the "receptacle," or head denuded of flowers, is markedly conical in shape, when fully developed, and *hollow*. These two characters, in addition to the odour, distinguish this plant from the scentless mayweed.

Opinions differ as to the relative merits of the wild and cultivated forms of chamomile and of German chamomile for hair-tinting purposes. All three would appear to be serviceable.

USES OF CHAMOMILE

Powdered chamomile flowers are sometimes used for hair-dyeing in packs, alone, or mixed with henna or other substances, in a manner resembling the application of henna dyes, mixtures of powdered chamomile flowers and henna containing from 25 to 75 per cent of the former being useful for dyeing hair shades of red having more gold in them than is obtainable by means of henna alone. The more usual employment, as a dainty colour-tonic for fair hair, is in the form of a simple infusion of the flower-heads in water as a hair-rinse, or a combination of them with cleansing agents as a shampoo.

Poucher (*Perfumes, Cosmetics and Soaps*) gives the following formula for a chamomile shampoo-powder :—

Powdered chamomile flowers . .	50 grams.
Borax	250 ,,
Dried sodium carbonate . .	500 ,,
Saponine	20 ,,
Soap powder	180 ,,
Oil of chamomile	1 gram.
Amber liquid	4 grams.

PLATE V.

FIG. 8.—WILD OF GERMAN CHAMOMILE
(*Matricaria Chamomilla*).

[*To face p.* 78.

THE CHEMISTRY OF CHAMOMILE—APIGENIN

Chamomile oil, obtained by distillation from the dried flower-heads, is, when fresh, a blue-coloured liquid, with the peculiar odour of the plant, and easily soluble in alcohol. On exposure to light and air it soon becomes a greenish or brownish yellow. It takes at least 25 lbs. of dried chamomile plants, or from 7 to 14 lbs. of the dried flower-heads to produce 1 oz. of the oil, with the result that it is a very expensive material. Foreign chamomile oils are often heavily adulterated.

Several researches have been carried out to determine the chemical composition of chamomile oil. The main constituents are compounds of organic acids and alcohols, known as esters. The chief acid is one chemists have christened with the attractive name of " angelic acid." Amongst the alcohols, there is a peculiar one, called " anthemol," about which very little is known.

The blue colour of the oil appears to be due to the same substance responsible for the blue colour of some other essential oils, and called " azulene " by Piesse. It is a very remarkable substance, whose properties have been investigated by Sherndal.* Azulene is a hydrocarbon, having the formula $C_{15}H_{18}$. Its colour is a most intense blue ; but, when exposed to light and air, it is converted into a brown resin.

These results do not support the view, which has been expressed on insufficient evidence, that chamomile owes its tinctorial powers to substances contained in the oil ; though it is just possible, in spite of the very small proportion in which it is present, that the azulene resin may have some effect in this direction.

On the other hand, amongst the many substances identified in the non-volatile part of an extract of the flower-heads, in a very elaborate research by Power and Browning,† apigenin was found to be present, both in a free state and combined with a sugar to form a glucoside. Now, apigenin is a yellow dye, though possessed of rather feeble powers. It is a trihydroxy derivative of flavone, a substance already mentioned as one

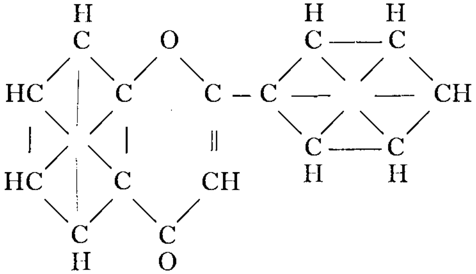
---

* *Journal of the American Chemical Society* (1915), Vol. 37, pp. 167 and 1537.

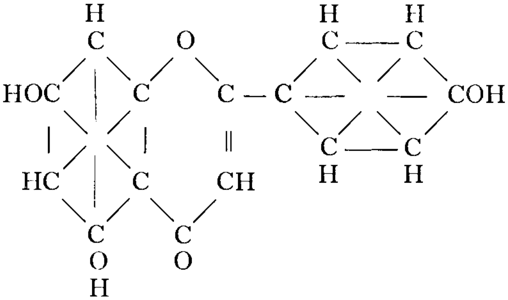
† *Journal of the Chemical Society* (1914), Vol. 105, p. 1829.

whose derivatives are responsible for many of the yellow colours in nature.

The chemical formulæ of these two substances are shown below :—



Flavone.



Apigenin
(1,3,4′-trihydroxy-flavone).

The same chemists also found apigenin and a glucoside of it amongst the bodies present in the flower-heads of German chamomile.*

Chamomile, therefore, is correctly described as a hair-dye. It gives just that touch of light gold to fair hair which has lost tone, either through the bleaching of the sun or from other causes ; and, being perfectly harmless in every way, it is a most useful constituent of hair-washes and shampoo-powders destined for use by blondes.

---

* *Journal of the Chemical Society* (1914), Vol. 105, p. 2280.

CHAPTER XIII

COAL TAR DYES—PARA

At one time a radical distinction was drawn between organic and inorganic substances, the former being thought to be formed as a result of a vital force peculiar to living beings. The progress of synthetic chemistry has rendered this distinction invalid, and the term " organic " is used by chemists nowadays merely to designate the very large family of substances containing the element carbon.

That synthetic chemistry should be called in to aid the hairdresser in the quest for a perfect hair-dye was inevitable, and we may conveniently classify organic dyes into two groups : (*a*) those obtained from plants ; and (*b*) those synthetically prepared. The former have been fully dealt with in the preceding chapters—the latter now call for attention.

Another distinction may be drawn. It is an interesting and perhaps significant fact that the organic substances used for hair-tinting obtained from plants, such as the juglone of walnut extract, the lawsone of henna, the apigenin of chamomile, the chrysophanic acid of rhubarb, the tinctorial principles of logwood and allied dyes, tannin, gallic acid and pyrogallol, are all, indigo excepted, compounds of carbon, hydrogen and oxygen alone. The synthetic hair-dyes, on the other hand, all contain nitrogen, in addition to other elements.

Nitrogen is wonderfully protean. In the elemental state, it is one of the most inert substances ; and, present in the air to the extent of nearly 80 per cent., it serves to dilute the active oxygen, like the soda-water in a whiskey and soda. Yet the most violent explosives, such as T.N.T., are compounds of this inert element. The most deadly poisons—the alkaloids and cyanogen compounds—all contain nitrogen. So, too, do the proteins—essential constituents of the food we eat. Without nitrogen, life as we know it would be impossible. Nitrogen gives life ; it gives death. It gives also colour—the majority of the myriad-hued dyes obtained from coal-tar being compounds of this extraordinary element.

From the same source as these latter come a number of substances used for hair-dyeing, the most important being, undoubtedly, para-diamino-benzene or para-phenylene-diamine, known familiarly in the hairdressing trade as " para."

THE CHEMISTRY OF PARA

The chemistry of para is unfortunately rather complicated, yet a knowledge of it is necessary in order to understand the action of this substance and the advantages and disadvantages of its use. An endeavour will be made to explain this very technical subject as simply as possible.

The starting-point for the manufacture—and for the understanding—of para is benzene, a hydrocarbon obtained from coal-tar. The molecules, or smallest particles of this hydrocarbon, each contain a perfectly symmetrical ring of six carbon atoms, to each of which is attached a single atom of hydrogen, the chemical formula of the substance being, therefore, C_6H_6. By appropriate means, one or more of these hydrogen atoms can be replaced by other elements or groups of elements ; in fact, a whole series of kaleidoscopic changes can be brought about, the ring of six carbon atoms, which is extraordinarily stable, remaining unbroken.

When one or more of the hydrogen atoms is replaced by a corresponding number of " amino groups " (an amino group consists of a nitrogen atom to which is attached two hydrogen atoms) the resulting product is called an " amino-benzene." Ordinary amino-benzene or aniline, $C_6H_5NH_2$, results when one such hydrogen atom is thus replaced. Diamino-benzene, $C_6H_4(NH_2)_2$, results when two hydrogen atoms are each replaced. There are three diamino-benzenes, differing from each other according to the relative positions of the two amino groups. In para, these groups are attached to carbon atoms which are *directly opposite to each other in the ring* (or, as chemists say, " are in the para position "). This point is of great importance, for it is undoubtedly due to the *positions* of the amino groups that para owes its properties as a dye. As to the actual manner of introducing these groups in the correct positions, this is a question which need not concern us, as it is one for the manufacturing chemist to solve, not the user of para. It will suffice to say that several more or less complicated methods have been devised.

Para is soluble in water and also in alcohol. It is a basic substance, combining with acids in the same manner as ammonia does. The compound of para with hydrochloric acid is known as "para-phenylene-diamine hydrochloride," and is used for making hair-dyes. It is easily soluble in water.

When pure, para forms colourless crystals ; but on exposure to the air they darken, as do also solutions of the substance.* This change is due to absorption of oxygen, the action being much facilitated by the addition of a suitable oxidising agent, such as potassium dichromate, or, especially, hydrogen peroxide. The resulting colouring matter is capable of dyeing the hair black, or lighter shades if sufficiently diluted, the colour, in point of tone and solidity, being a very perfect imitation of Nature, and leaving little if anything to be desired from an æsthetic point of view.

THE OXIDATION OF PARA

What happens when para absorbs oxygen ? For a complete understanding of the action of para as a hair-dye, a fairly full consideration of this question from the chemical point of view is necessary.

With Erdmann,† we may consider the formation of the colouring matter as taking place in two stages. First, we may say that the action of the oxygen is to deprive each molecule of para of two hydrogen atoms. These combine with the oxygen to form water, the para being converted into quinone-di-imine, $C_6H_4(NH)_2$, which substance then condenses to form the colouring matter itself, a substance of very complex constitu-

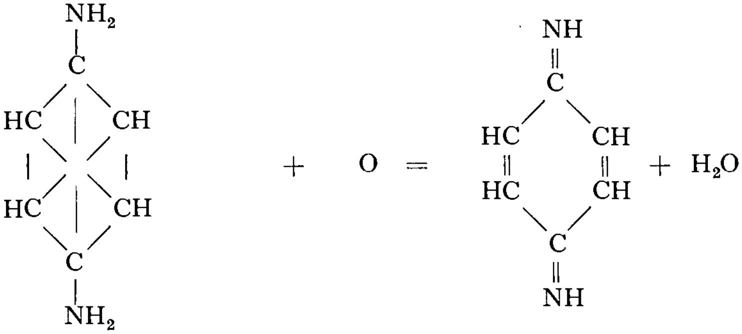
---

* According to a recent patent (British Patent, No. 269,583), compounds produced by acting on para and allied substances in benzene solution with dry sulphur dioxide, and which do not undergo oxidation in the air, are proposed for use as hair-dyes.

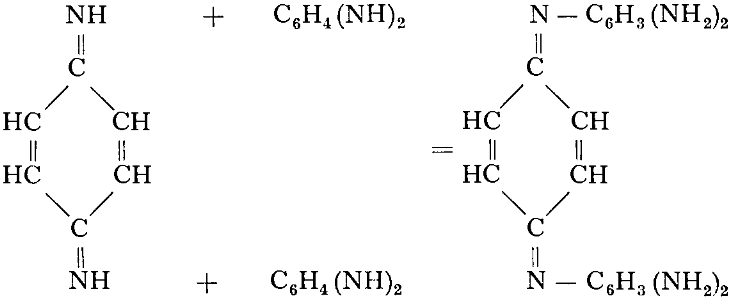
† *Berichte der deutschen chemischen Gesellschaft* (1904), Vol. 37 (3), p. 2906.

tion, known as " Bandrowsky's base," after the name of the chemist who first investigated it.

These two stages in this very interesting reaction are diagrammatically represented below :—



Para-phenylene-diamine + Oxygen = Quinone-di-imine + Water



Quinone-di-imine + 2 Quinone-di-imine = Bandrowsky's Base

Bandrowsky * obtained his " base " in the form of bronze-coloured crystals containing water, and it is possible that the decidedly black colour formed when hair is dyed with para may be due to further reaction between the " base " and the keratin, though this, it should be added, is purely conjectural.

When para is converted into quinone-di-imine, although the ring of six carbon atoms is not broken, the attractive forces between these atoms are disturbed and undergo a rearrangement, as shown by the lines in the diagrams. This new

---

* *Berichte der deutschen chemischen Gesellschaft* (1894), Vol. 27 (1), p. 480.

arrangement of forces lacks the perfect symmetry of that existing in the molecules of para or benzene, and is called " quinonoid " by chemists. As pointed out in Part I., it is a remarkable fact that many organic colouring matters have a quinonoid structure, examples being afforded by the juglone of walnut extract, the lawsone of henna, etc.

ARE PARA DYES DANGEROUS ?

Before dealing with the composition and uses of para dyes, it will be as well to face the question : Are para dyes dangerous ? An affirmative answer must certainly be given. The numerous accidents which have occurred, some of an extremely grave character, render any other reply impossible. Several successful actions have been taken against hairdressers in this country by clients poisoned by means of para, heavy damages being awarded ; and it may very justly be said that it is para which has created the impression that hair-dyeing is at best a hazardous undertaking, and that all dyes—which most certainly is not the case—are dangerous poisons.

According to M. Schueller (*Les Teintures pour Cheveux*) the toxic action of para is due to the quinone-di-imine, the actual pigment being harmless when once formed, a view seemingly difficult to harmonise with the fact that dermatitis has been known to occur as a result of wearing postiche or furs dyed with para or allied substances. In any case, when para is used to dye living hair, apart from its action as a violent irritant on the skin, there is a danger that it may enter the blood stream, where no substance so avid for oxygen could fail to threaten havoc. The effects of para poisoning, which will be dealt with more fully in Part III., Chapter VI., are very distressing and painful, and, indeed, the poisoning, unless properly attended to, may eventuate fatally.

It is a remarkable fact that all persons are not equally liable to the toxic action of para. It is maintained, in fact, that this liability is an idiosyncrasy, similar to that shown by certain folk who cannot eat shell-fish with safety. Various estimates have been made of the proportion of persons possessing liability to para poisoning. Some authorities have put the figure as low as 2 in 1,000. M. Schueller (*De l'innocuité des teintures pour cheveux*), on the other hand, as a result of considerable personal experience, put the proportion at about 3 to 5 per cent. It is, perhaps, most correct to say that there is a possibility of poisoning whenever para comes in contact with the skin, but that in the majority of cases the healthy functioning of the human system prevents the development of the symptoms.

Drs. Sabourard and Rousseau have devised a test, known by their names, to determine the liability of a person to para poisoning, which is fully described in Part III., in the chapter on "The Technique of Applying Liquid Dyes." However, leaving aside home usage, for which para dyes are totally unsuited, hairdressers may find it wisest to stick to those dyes which, although perhaps more difficult to apply in order to produce results equal to those given by para, are free from danger, and whose use can lead to no unpleasant consequences harmful either to their clients or themselves.

PREPARATION OF PARA DYES

Para was first proposed for use as a hair-dye by Monnet et Cie. of Paris (French Patent, No. 158,558) in 1883; and, in spite of the dangerous character of this and allied substances, para dyes have tended to be increasingly employed in those countries where their use has not been restricted by legislation. This, no doubt, is due to the fact that they are easily applied, give very permanent colours, highly satisfactory from an artistic point of view, and are capable of a fine degree of graduation. The graduation, it may be added, is achieved both by means of dilution and by the addition to the para of other dyes chemically allied to it. Moreover, hair dyed with para can be permanently waved without difficulty, which is not the case if metallic dyes are used.

For preparing the dyes, either para itself or its hydrochloride may be employed in aqueous solution. In either case, however, it is advisable to add an alkali. This not only facilitates the oxidation and consequent formation of the colouring matter, but also enables the para to penetrate the hair. It is because of this penetration and consequent deposition of the colouring matter within each hair, that para dyes are found to be so remarkably permanent.

An early formula by Erdmann prescribed 20 grams of para and 14 grams of caustic soda (sodium hydroxide) dissolved in 1 litre of water for a dye to produce black. However, the use of caustic soda to render the solution alkaline is very objectionable, owing to the destructive action of this substance on both hair and skin. The use of ammonia, or, better still, sodium bicarbonate, as proposed by Guesquin, is much to be preferred.

OXIDANTS FOR USE WITH PARA

The air itself may be relied upon to do the work of oxidising para, and the method indicated has been used in the past, para being employed as a progressive dye. But this mode of application, which possesses no advantages and entails the maximum risk of para poisoning, is obsolete.

In the specification of Monnet's patent, referred to above, potassium chlorate mixed with a trace of a salt of the metal vanadium is one of the oxidants proposed. Its action is slow. Potassium dichromate is another oxidant proposed, whose use has also been recommended by other authorities. A number of formulæ incorporating this substance have been published. The usual strength employed is that of a 5 per cent. solution, mixed with the para before application or applied to the hair immediately afterwards.

Hydrogen peroxide, however, appears to be the best oxidant and the one most employed nowadays. This can be applied to the hair immediately after treatment with the para dye ; but the modern, and better, practice is to mix the peroxide with the dye in a saucer *immediately* before application.

The most useful strength is 15 vols., but weaker solutions may be employed depending upon the concentration of the para solution and the intensity of the shade desired.

Various solid preparations which give hydrogen peroxide solutions of known strength, which have been already described in Chapter II. of this Part, are also used in connection with para dyes, and possess obvious conveniences.

COMPOSITION OF MIXED PARA DYES

A number of substances chemically allied to para give colouring matters on oxidation, undergoing chemical changes similar to those taking place in the case of this latter substance. Some of these have been proposed as improvements on para, others are employed as adjuncts to it for the purpose of giving a wider range of shades. Of the latter, para-toluylene-diamine, $C_6H_3(CH_2)(NH_2)_2$, and para-diamino-phenol, $C_6H_3(OH)(NH_2)_2$, may be specially mentioned. The first is employed for the production of ash shades, the latter to give reds. Either the free bases may be used, or, preferably, the hydrochlorides. The hydrochloride of para-diamino-phenol, it is interesting to note, is well known to photographers as a developer under the name of "amidol." The fact is remarkable that many photographic developers are also hair-dyes, para itself providing another instance, as does also pyrogallol already mentioned.

The following formulæ for the preparation of para dyes indicate the use of para-diamino-phenol.

	Black.	Chestnut.	Red-blonde.	Blonde.
Para-phenylene-diamine	20 grams.	5 grams.	2 grams.	1 gram.
Para-diamino-phenol .	*Nil.*	5 ,,	10 ,,	2·5 grams.
Water (distilled and, if desired, perfumed) .	1 litre in each case.			

A small quantity of an alkali (*e.g.*, 0·5 to 1 per cent. of 0·880 ammonia) should also be added, and the addition of small quantities of resorcinol, $C_6H_4(OH)_2$, is said to be advantageous.

SOME OTHER COAL TAR DYES

The dangerous character of para has caused research to be made for chemically similar bodies, capable of dyeing the hair as easily as para and producing the same satisfactory results, but of a less toxic character. Many substances have been proposed for use. These fall into two groups. On the one hand there are a number of different diamines and aminophenols, whilst on the other there are certain sulphonic acids, obtained by combining, under proper conditions, substances belonging to the first group with sulphuric acid.

The substances in the first group, in addition to the two already mentioned in the preceding section, include para-amino-phenol, methyl-para-amino-phenol (the sulphate of this base is the photographic developer " metol "), 1, 2-naphthylene-diamine, and other more complex substances. These, however, do not call for extended notice. They all, speaking generally, share the toxic properties of para ; and, whilst some are employed in addition to this latter substance to modify the shade produced, none have succeeded in replacing it.

The use for hair-dyeing purposes of the sodium salts of the sulphonic acids of para-phenylene-diamine, and other diamines and amino-phenols, is a German invention dating from the early years of the present century. The method is of interest because sulphonation, as the process of combination with sulphuric acid is called, does seem appreciably to diminish the toxic properties of the bodies in question. Unfortunately, it also diminishes their tinctorial powers ; and these sulphonic compounds appear to be little, if at all, employed nowadays, owing to the fact that several applications of the dye were generally found to be necessary in order to produce satisfactory results. The chemistry of these substances, whilst very interesting, is complicated. Readers desirous of further information are referred to British Patent, No. 14,212, of 1905, which is now no longer in force.

CAN PARA BE MADE SAFE ?

Another line of research has been directed to solving the problem of making para safe. Several methods have been proposed. Those based on inaccurate notions of the toxic action of para need not detain us. For example, one patent was taken out for a process based on the preposterous idea that the toxic effect of para was due to the fact that it formed needle-shaped crystals !

Without, however, making any comments on its merits or demerits, a patent by Mr. R. L. Evans, of New York, which is still in force (British Patent, No. 234,971), seems worthy of mention. According to this invention, the para is chemically coupled with acetone sodium bisulphite or some similar substance yielding a compound which is slightly dissociated in solution, and which, therefore, " acts as a reservoir, liberating the amine (para) as it is used up by the usual oxidising agent, such, for instance, as hydrogen peroxide in the process of dyeing."

CHAPTER XIV

SUMMARY AND CONCLUSION

IN reviewing the various substances used for dyeing the hair, one is forced to recognise that, in spite of the very real utility of a number of preparations, the ideal hair-dye has yet to be discovered. This is particularly the case concerning the problem of dyeing the hair black or dark brown. The production of golden and auburn shades is more easily accomplished. Hydrogen peroxide is in all respects very satisfactory for bleaching the hair, provided it is used with care. Henna, unmixed with other dyes, is ideal for the production of auburn. And as a colour-tonic for fair hair and hair of medium brown, chamomile and henna, respectively, are unequalled. But the range of utility possessed by these substances is limited. They leave the problem of dyeing grey hair black untouched.

WANTED—AN IDEAL DYE

The ideal hair-dye must be *perfectly* harmless, devoid of toxic properties and without any deleterious effects on the hair itself. It must produce permanent colours equal to those of Nature, and must be easy to apply. Moreover, in these days when permanent waving is so much resorted to, the ideal dye must not render the hair unresponsive to this treatment, or only capable of being permanently waved with difficulty, a demand which would seem to cut all metallic dyes out of the category of the ideal. And further, it may be said that to be really ideal, a dye should consist of two or three solutions of such a nature that, by adjusting the proportions of each, any and every possible shade could be produced.

THE QUESTION OF HARMLESSNESS

With reference to their toxic qualities, hair-dyes may be divided into three groups, and, for the sake of completeness, kohl and hydrogen peroxide (which, speaking correctly, are not dyes) are included.

In the first group, the members of which are perfectly harmless, can be placed all dyes of vegetable origin, except pyrogallol, dyes based on iron, potassium permanganate, hydrogen peroxide and kohl made from amorphous carbon.

The second group contains pyrogallol and the majority of metallic dyes. These all possess some toxic properties, copper salts, perhaps, to a less degree than those of silver, silver salts certainly to a less degree than those of lead. But the dyes based on these substances are not really dangerous, provided the toxic ingredients are not present in too high a degree of concentration—a matter of great importance, which has been referred to previously—and reasonable care is taken in using the preparations.

The third group contains the dangerous dyes, namely, those based on para and allied coal-tar products, and a few, more or less obsolete, dyes based on such highly toxic metals as mercury.

Regarding the action of the various substances on the hair itself, a matter which has sometimes been overlooked in discussing this question, the researches of Dr. Leftwich have shown some of the substances, as indicated in the table below, to have practically no deleterious action on the tensile strength of the hair, whilst the effect of others was seriously to diminish it.

EFFECT OF SUBSTANCES ON TENSILE STRENGTH OF HAIR
(Leftwich)

Little or no Effect.	*Strength Reduced.*
Alcohol.	Alkalies.
Hydrogen peroxide.	Mineral acids.
Lead acetate (12½ per cent. solution).	Silver nitrate (10 per cent. solution).
Aniline dye.	Pyrogallol (10 per cent. solution).

The very deleterious action of sodium mono-sulphide has been referred to already.

COLOUR AND EASE OF APPLICATION

The most difficult dyes satisfactorily to apply are those of vegetable origin. Henna-reng might, as we have already indicated, be classed as the ideal dye, but for this one fact; for it is perfectly harmless and gives a big range of excellent and lasting shades from red to black. It may be further noted, as a strong point in their favour, that compound hennas of a purely vegetable character permit the hair to be permanently waved without difficulty after application.

The metallic dyes are usually easy of application, as are also those based on para. The latter give a splendid range of very natural and lasting shades. The future advancement of hair-dyeing may lie in the finding of a solution to the problem of making para safe. Alternatively, it may lie in the discovery of new synthetic dyes or in improved methods of applying those derived from henna and other vegetable substances.

THE CHEMISTRY OF HAIR-DYES

In connection with the question of the future of hair-dyeing, that of the chemistry of hair-dyes is all important. As will be evident from what has been said in previous chapters of this series, it is an essential feature of all hair-dyes to deposit, during the action of dyeing itself, an insoluble pigment in or on the hair. In the chemical reactions resulting in this pigment, not only the constituents of the dye, but also the atmosphere and the hair itself may take part.

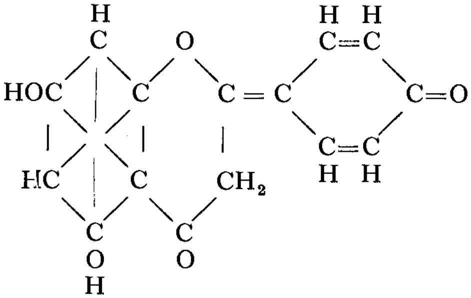
In the case of henna, we have pointed out that there is little doubt that combination takes place between the dyestuff, lawsone, and the keratin of the hair, a fact which accounts for the great effectiveness of this dye, which is a true " substantive dye " for hair. Similar reactions may take place, as indicated in previous chapters, in the case of some other dyes, though very little is known definitely concerning this matter. Metallic dyes of the progressive type take advantage of the presence of sulphur in the keratin, the pigment formed being a coloured metallic sulphide.

The atmosphere plays a part in dyeing with walnut extract, rasticks and other dyes in which the pigment is produced by oxidation, without the addition of an oxidising agent.

There are many types of reactions taking place between the constituents of dyes, the simplest being the " double decomposition" undergone in certain types of two-solution ("instantaneous") metallic dyes. In addition, mention may be made of the following types of reaction: (i) pigment produced by means of reduction (silver-pyro dyes); (ii.) pigment produced by oxidation by means of hydrogen peroxide or other suitable oxidant (para dyes); and (iii.) pigment produced by the decomposition of a glucoside, or sugar compound, as in the case of indigo-leaves (used in henna-reng) and chamomile.

Concerning the chemical composition of the pigments obtained, these fall roughly into two groups: (i.) metals and metallic compounds, *e.g.*, silver, metallic sulphides, manganese di-oxide, etc.; and (ii.) organic, or carbon-containing, compounds. The majority of these latter possess the peculiar type of molecular structure known as "quinonoid," those obtained from vegetable sources (indigo excepted) being composed of carbon, hydrogen and oxygen alone, the coal-tar dyes (para, etc.) containing nitrogen in addition.

To the chemist—and the general reader will perhaps pardon us for saying one or two words which may be unintelligible to him—it is of interest to note that it is possible that even the flavone and flavonol dyes may possess a quinonoid structure, seeing that in each case a hydroxyl group is substituted in the benzene nucleus in the para position to the carbon atom attached to the carbon atom of the *gamma* pyrone ring, the formula for apigenin, for example, being written:—



PART III

THE PRACTICAL ART OF HAIR-DYEING

CHAPTER I

THE TECHNIQUE OF THE WET SHAMPOO

As pointed out in Part I., before hair can be successfully dyed it is nearly always necessary for it to be thoroughly cleansed and defatted. Some authorities recommend a simple wash containing ½ per cent. of crystallised sodium carbonate (washing soda) for this purpose. We prefer a shampoo ; and we therefore commence the practical part of our book with a full consideration of the art of shampooing.

It is an ancient art which has been much developed in recent days by the introduction of almost innumerable varieties of shampoos—shampoos in powder form and liquid form, dry shampoos, spirit shampoos, oil shampoos, medicated shampoos, and shampoos containing tinctorial principles such as chamomile, henna and rhubarb, further variety being introduced by the use on the part of manufacturers of various, and sometimes distinctive, perfumes, designed to increase the attractiveness of their preparations.

CLASSIFICATION OF SHAMPOOS

Shampoos containing tinctorial principles, such as chamomile, henna, etc., should, perhaps, be classed as hair-dyes. Their composition has been indicated in preceding chapters, and, as pointed out, their effect on the colour of the hair is only slight. They are useful as colour tonics, and are mainly intended for home usage. Henna should be employed for medium to dark hair, chamomile for lighter shades.

Leaving apart these and other special preparations, ordinary shampoos may be roughly classified in accordance with the liquid employed, as under :—

(*a*) Wet shampoos—water.
(*b*) Dry shampoos—alcohol or other volatile liquid.
(*c*) Oil shampoos—various oils.

It may be added that the name "dry," which, in deference to trade usage, we adopt for class (*b*), is really a misnomer, the term properly applying to powders used as such for cleansing the hair without mixing with water or other liquid. These latter preparations, however, are worthless, and should not be employed.

In this chapter we are concerned with shampoos in which the liquid used is water.

SOAPS AND SHAMPOO POWDERS

Any good soap can be used in conjunction with water to shampoo the hair ; but hairdressers as a whole find "liquid soap" the most convenient form. "Liquid soaps" consist essentially of strong solutions of soft soap in weak alcohol, together with a little free alkali. Soft soaps, it may be added, are made by saponifying suitable oils, such as olive oil and palm oil, with caustic *potash*, the glycerine produced at the same time remaining in the soap. The following formulæ from Poucher's *Perfumes, Cosmetics and Soaps*, illustrate the composition of these preparations.

	No. 1.	No. 2.
Soft soap	100 grams.	50 grams.
Alcohol, 90 per cent. . .	250 c.c.	150 c.c.
Perfume	10 c.c.	10 c.c.
Caustic potash, 5 per cent. solution	50 c.c.	*Nil.*
Ammonia, ·880 . . .	*Nil.*	20 c.c.
Saponine	*Nil.*	20 grams.
Water to produce . .	1 litre.	1 litre.

Of these, No. 2 is preferable, as free caustic potash is harsh in its action.

The composition of the coconut oil shampoos, so popular at present, follows along similar lines, these preparations being made by saponifying coconut oil with caustic potash so as to form a soap. The beneficial effect of coconut oil on the hair has long been recognised, though it should be added that coconut oil shampoos are not suited to every scalp.

In addition, many varieties of shampoo powders exist, consisting usually of powdered soap mixed with mild alkalies, such as the carbonates of sodium and potassium and borax. Saponine is another frequent ingredient. These shampoo powders are mainly intended for home usage, and, mixed with water, make suitable shampoos for defatting the hair. Complete dissolution of the powder in the water is essential.

THE METHOD OF WET SHAMPOOING

To shampoo the hair properly necessitates a constant flow of water, of which the temperature can be regulated, and skill on the part of the operator. Moreover, it can best be done by some one other than the person whose hair is being washed, for the one reason, if for no other, that it is difficult to see the back of one's head ; and the competent hairdresser, therefore, is the best person to be entrusted with the operation. The process, indeed, may seem too well known to stand in need of a detailed description ; but there are a number of points in connection with it which call for consideration and emphasis. And, first of all, let us say that the wet shampoo should be made as pleasant as possible. The client must be seated comfortably close to the basin and not required to lean over it longer than is absolutely necessary, and the operator must take care that the water flows at the right temperature as dictated by the client's taste.

The client being properly seated, the hair is brought over the head so that it falls clear of the towels and the sides of the basin. It is then thoroughly saturated with water, being lifted up by the operator's left hand to facilitate penetration. The water is directed on to the head by means of the rose, held in the operator's right hand. This preliminary rinsing must be thorough.

After the preliminary rinsing has been effected, the " liquid soap " is poured on to the head by the operator's left hand, and at the same time worked into a lather with the right. Both hands are used as soon as the lather forms freely. The soap is then worked thoroughly into the hair with a massage-like movement of the fingers. The method of doing this is of fundamental importance, as thorough cleansing depends upon the correct movement of the fingers. These should always be held in a claw-like fashion as shown in Fig. 9, where the same process is illustrated for the case of the dry shampoo, and moved in a rotatory fashion. Adherence to this plan will obviate any danger of the hair becoming entangled ; and the method is an excellent one for loosening dandruff and other deleterious matter which may cling to the scalp. Moreover, a rotatory movement of the tips of the fingers is not only best from the point of view of cleansing the hair, but it invigorates and produces a pleasant sensation in the scalp.

It is advisable to lather twice, the first lather being well rinsed away before the second is produced. It will be found that the second lather is produced more easily than the first, for the reason that the major portion of the grease will have been already removed. There are exceptional cases where, for example, there is an excessive secretion of sebum or where there has been over-use of greasy dressings, in which it will be found necessary to lather three times in order completely to cleanse and defat the hair.

During rinsing, it is desirable that the hair should be kept on the move by means of the operator's fingers, in order to allow the water to penetrate ; and the rose must be held close to avoid splashing. The water must be carefully directed in the vicinity of the forehead and around the ears in order to prevent it, so far as possible, from running over the client's face ; and his or her wishes should be consulted with reference to changing the temperature from hot to cold.

When shampooing a lady with long hair, the hair, after rinsing, should be gathered up in the hands and as much water wrung out as possible ; preliminary drying is then effected as follows : The operator holds the long hair with one hand and brings the towel forward to the forehead with the other.

Without loosening the towel from the neck, he rapidly wipes the neck and around the ears, and presses the towel to the forehead. The client is then asked to sit in an upright position—a request which will not need repeating.

In some establishments one large, heavy towel is used for shampooing, whilst in others two are employed, one being tucked round the neck and used for preliminary drying as described above, the other employed in addition to absorb more of the moisture preparatory to complete drying with the mechanical dryer.

In the case of a heavy head of hair, it may be necessary to wring it in the towel, in which case the position of the left hand should be underneath, the right hand working on the top in a direction away from the scalp.

The best position for the operator to take up during preliminary drying is not immediately behind the client, but somewhat to one side, in which position it will be found easy to rub the back and sides of the head in an upward direction. When the top of the head is being rubbed, the operator must take care to avoid flicking the client's face with the towel.

We consider it important that the hair should be dried as completely as possible with towels before the mechanical dryer is brought into use. When it is wet with water, hair (as shown by the researches of Dr. Leftwich) is in a very much weakened condition. The effective drying of hair after a shampoo is, therefore, a matter of great importance, although, unfortunately, this is not always recognised. Full details concerning mechanical dryers and their use (and abuse) will be found in Chapter IV. of the present Part.

AN ALTERNATIVE METHOD OF SHAMPOOING

The use of " liquid soap " renders possible an alternative method of shampooing which has been found to be not only very efficacious but pleasanter to clients, as it entails a shorter period of leaning over the basin. Whilst, however, we strongly advocate this method, it should only be employed with high-grade " liquid soap " containing no free caustic alkali.

The method is as follows : The client is enveloped in the usual dressing cloth, one towel being placed across in front, another at the back. The hair is well brushed and parted down the middle. In the case of a lady who has not yet succumbed to fashion's dictates and had her hair shingled, the parting must be carried to the ends of the hair. If the hair is extra thick, it may be divided into three or four sections.

The hair is then thoroughly moistened with bay-rum, toilet cologne, perfumed water or antiseptic solution. This is effected by means of an ordinary saloon spray, the hair being well brushed during the operation. When the hair is thoroughly wetted, a small quantity of " liquid soap " is applied, about 6 c.c., or, roughly a teaspoonful, being usually found sufficient for this purpose. The soap is worked well into the hair and scalp in order to obtain a good, stiff lather, after which the head is rinsed for a moment under the rose, the client leaning over the basin.

A thorough massage follows, effected by the fingers held in the claw-like fashion already indicated and moved in a rotatory manner. This process produces very considerable lathering, the lather being of the right consistency to effect a thorough cleansing. The massage is continued until the scalp is quite free from deleterious matter. The lather is then rinsed off and a second lather produced in a similar manner, the hair being finally rinsed and preliminary drying effected as in the method previously described.

It will be noticed that during the major portion of the time taken by a shampoo effected in this manner, the client is sitting up in the chair, able to converse in perfect ease and comfort. The somewhat disagreeable necessity of hanging the head over a basin is reduced to a minimum. Nevertheless, the method entails a maximum of cleanliness. Not only is it pleasant, but clients of both sexes have a distinct preference for a process like this *which can be seen.*

This method of shampooing, if correctly carried out, obviates the danger of leaving the hair dull and mousy in appearance or in a sticky condition. The latter is an important matter when hair is shampooed preliminary to hair-dyeing. In order to assure satisfactory dyeing, it is essential that the hair is thoroughly cleansed from grease and is not left in a powdery or tacky condition. Thorough rinsing is imperative. It is non-attention to this fact which often accounts for shampoos being unsatisfactory in their effects.

CHAPTER II

THE TECHNIQUE OF THE DRY SHAMPOO

As indicated in the last chapter, the term " dry shampoo " may be held properly to apply to preparations put up in powder form and used in this form for cleansing the hair. The basis of such preparations is usually powdered orris-root, generally mixed with starch and mild alkalies, extra perfume material often being added. The powder is applied to the hair dry, allowed to remain in contact with it for a considerable period, and then brushed out. As we have already said, these preparations are perfectly useless, and, indeed, must be condemned as injurious. Not only do they fail to cleanse the hair, but they have a tendency to clog the pores of the scalp, producing harmful results.

The term " dry shampoo " is usually employed in the hairdressing trade to designate liquid preparations of a more volatile character than water, and which therefore dry rapidly, and it is with this meaning that we shall employ the term in the rest of this chapter.

THE COMPOSITION OF DRY SHAMPOOS

Various volatile liquids have been employed for the preparation of dry shampoos. Petroleum spirit had a big vogue at one time ; but, owing to the occurrence of serious and fatal accidents, due to the inflammable nature of this material, its use has been largely discontinued, at any rate in Great Britain.* Nor has carbon tetrachloride fulfilled the hopes which were entertained, the toxic character of its fumes having caused some very serious accidents. The liquid usually employed is dilute alcohol, the composition of dry shampoos resembling that of " liquid soaps," except that bulk for bulk they contain

---

* See " Note on Petroleum Hair Washes " at end of this Chapter.

more spirit (about 50 per cent.), and a lower proportion of soap and other cleansing agents, seeing that they are not to be diluted by the addition of water.

The form of alcohol generally used is industrial methylated spirits, which contains wood naphtha in addition to the alcohol, permission being given for this purpose by the Commissioners of Customs and Excise in the case of preparations of approved formulæ. There is another variety of industrial methylated spirits, which contains pyridine in addition to the wood naphtha and alcohol, and it would appear that sometimes this is used for making dry shampoos, a practice which is to be strongly deprecated, owing to the poisonous character of pyridine.

It is, indeed, of the utmost importance that dry shampoos should be prepared from harmless and pure ingredients, as too many cases have occurred of operators contracting dermatitis as a result of working with inferior preparations. No doubt some persons have very delicate skins and may be said to possess a predisposition towards dermatitis; but the idiosyncrasy theory can be pushed too far, and certainly is pushed too far when it is used as an excuse for placing on the market deleterious products. In any case, it is inadvisable for operatives to allow the dried lotion constantly to collect between the fingers; cleanliness here is as desirable as in every branch of the hairdressing art.

"Ice lotion," which is a special form of dry shampoo very refreshing and much appreciated in hot weather, may be mentioned in passing, although not particularly relevant to the art of hair-dyeing. The cooling effect of the ice lotion is produced by means of menthol.

IS THE DRY SHAMPOO CLEAN?

The introduction of the dry shampoo some twenty-five years ago changed the aspect of the shampooing art altogether. Many hairdressers, who had hitherto had little or no acquaintance with shampooing, began to practise it. It needed no hot water installation, was quick, easy and cheap, and specially adapted for a busy gentlemen's trade. Any barber's shop possessing a basin could adopt the dry shampoo, and most of them have done so ; so that to-day, from the smallest front-room parlour style of shop to the large West End establishment, the dry shampoo is employed. In a word, the introduction of dry shampooing may be said to have democratised the art ; and every year since its introduction, more people are shampooed by hairdressers than ever previously in the history of the profession.

Nevertheless, and perhaps because of its democratic character, dry shampooing is often carried out in a very inefficient and perfunctory manner ; and the question has seriously to be asked whether the dry shampoo is clean. This is a question of essential importance from the standpoint of this book, as no type of hair-wash is of any use as a preliminary to hair-dyeing unless it thoroughly cleanses and defats the hair. Judging from the composition of the dry shampoo, there is every reason to believe that it should prove effective. The cleansing properties of alcohol are well known, and, in addition to this, dry shampoos contain exactly those detergents which are found in " liquid soap." Moreover, dry shampooing has the additional advantage that it permits more rapid drying of the hair afterwards.

Nevertheless, the fact remains that dry shampooing can be, and too often is, unsatisfactory, leaving the hair and scalp in a dirty and messy condition. Considerable experience leads us to consider the following as the factors productive of unsatisfactory results :—

(a) Use of cheap, inferior lotions.
(b) Wrong method of application.
(c) Too liberal use of lotion.
(d) Flat-handed rubbing or massage.
(e) Wrong method of drying.

If, however, dry shampooing is properly carried out, it can be made as clean and as effective as that with soap and water. In order to achieve this, however, the operator must bear in mind that it is a *dry* shampoo, and that therefore the dirt and grease cannot be rinsed out as in a wet shampoo, but must be properly loosened and removed in a manner appropriate to the agent employed.

THE METHOD OF DRY SHAMPOOING

The first consideration and one whose importance we have already emphasised, is that of the quality of wash or lotion to be employed. A good quality lotion, free from pyridine and free caustic alkali, is imperative, the saving of a few pence on a pint of lotion being false economy. The second point to be borne in mind is that, while sufficient of the lotion must be employed in each case, over-lavish use only succeeds in messing up the hair.

The majority of the hairdresser's clients like to see a nice lather, and much is to be said in favour of washes which lather well ; since, other things being equal, they are the best calculated to emulsify the grease, though it would be a mistake to imagine that the cleansing powers of lotions are directly proportional to their lathering properties. There are good " friction lotions " or latherless shampoos on the market, which are useful as stimulants ; but these lotions are not suitable for defatting the hair.

Both the method of massage and that of drying are of great importance.

The lotion having been applied, massage is necessary in order that the hair may become saturated and the lather obtained. This must be effected by the operator's *fingers*. Many hairdressers rub with the palm of the hand ; but this method is absolutely wrong and, as already indicated, is one of the factors productive of a dirty shampoo. A flat-handed massage, in so far as it disturbs the dirt and grease, merely makes a mess, matting and entangling the hair, especially when this is of any considerable length. As in the case of the wet shampoo, the hands must be held in a claw-like fashion, so that the fingers penetrate the hair and massage the scalp, the correct position being shown in Fig. 9. This massaging should be continued until the hair is free of lather and the head is ready for drying.

The plan adopted by many hairdressers of wiping the head with a damp, but not too wet, sponge before drying is one to be commended. Not only does it remove any superfluous lather, but it helps to clean the hair. Moreover, it gives the operator a chance to rinse his hands under the rose, which obviates any risk of irritation being produced by the dried lather.

The method of drying the hair after a dry shampoo is important. The towel should be held in the manner shown in Fig. 10. This method of holding the towel makes it impossible for the ends to flick in the client's face, and nothing militates so much against the pleasure of a shampoo as getting a flick in the eye with a wet, and possibly dirty, towel. In drying, as in the previous phase of a dry shampoo, rubbing with the palm of the hand must be avoided. The head should be massaged by the hands held in a claw-like fashion underneath the doubled towel, a method which is not only more effective in drying the hair and in removing dirt and grease, but has the added advantage of invigorating the scalp. Failure to adhere to it means an unsatisfactory shampoo.

Dry shampoos are frequently spoilt by insufficient towelling, the mechanical dryer being brought into use too soon and the dirt dried on the hair. A good towelling is essential, the fingers being allowed to rotate vigorously, but not roughly, the operator remembering that whilst vigorous massage is beneficial, the client is not to be treated, as we fear sometimes is the case, as a person needing to be awakened from a trance by violent methods. After the towelling and before applying the dryer, it is necessary to comb the hair thoroughly. This prevents it becoming entangled and also facilitates the work of the dryer.

If dry shampooing is carried out in accordance with the rules laid down above, it will be found just as satisfactory a preliminary to dyeing as the wet method ; and the wishes may thereby be met of clients who, either through a high susceptibility to colds or for any other reason, prefer this method to that of the wet shampoo.

PLATE VI.

FIG. 9.—THE DRY SHAMPOO.
Massage.

FIG. 10.—THE DRY SHAMPOO.
Towelling.

[*To face p.* 106.

NOTE ON PETROLEUM HAIR WASHES

Some years ago the London County Council issued a circular on Petroleum Hair Washes to members of the hairdressing profession in the county which, in view of its importance, we reproduce here in full.

" Fatal and other serious accidents having occurred through the use of hair washes containing petroleum spirit, the London County Council considers it desirable to give notice that such liquids are petroleum mixtures within the meaning of the Petroleum Acts, and can be lawfully kept only in accordance with the provisions thereof.

" These hair washes are known by various names, such as ' Antiseptique Liquide,' ' Dry Shampoo,' ' Petrole,' and freely give off highly inflammable vapour at ordinary temperatures.

" The special danger arising in their use is that the liquid may be ignited by a light or fire some distance away. The vapour is heavier than air, and under certain conditions it will travel or flow considerable distances. Directly it reaches a light or fire the whole volume at once bursts into flame, and involves the spirit or mixture whence it proceeds. This has been known to occur even when the liquid was over 40 feet distant from the point of ignition.

" An electric spark will ignite the vapour, and petroleum spirit fires have occurred through ignition by electricity generated by friction in dry-cleaning clothes. The human hair is also rendered electrical by friction, and consequently there is a danger, when it is cleaned with a petroleum spirit hair wash, of ignition by an electric spark.

" The use of petroleum spirit hair washes is therefore so exceptionally dangerous that it is hoped hairdressers and others will do their utmost to discourage the practice."

CHAPTER III

THE TECHNIQUE OF THE OIL SHAMPOO

IN the two previous chapters, wet shampooing and dry shampooing have been considered mainly as means for defatting the hair as a preliminary to dyeing. The object of the oil shampoo, which may briefly be described as a scalp massage with a suitable oil, is exactly the reverse of this, its function being to supply additional oil to the hair when for any reason this may be necessary. As such, the oil shampoo occupies quite a different position in the art of hair-dyeing from that of the other types of shampoos.

The idea behind the oil shampoo and its *modus operandi* originated in America, where the process became known as the " oil cure," this term well indicating its nature as a curative treatment for certain abnormal conditions of the hair. It soon found its way from America to the Old Country, and is now widely known and practised here and on the Continent.

USES OF THE OIL SHAMPOO

The oil shampoo may be occasionally employed with advantage to invigorate the hair ; but its chief use is to rectify abnormal dryness. This dryness may result from some deficiency in function of the sebaceous glands, or, alternatively, it may be the effect of some special treatment to which the hair has been subjected. In cases where the first factor is operative, oil shampooing may be necessary as a preliminary to dyeing, not, of course, carried out *immediately* before the dyeing, but some little time previously, in order to get the hair into a healthy condition before the colour change is effected. Moreover, as we have seen, hair must nearly always be defatted before it is dyed ; and it may be urged as an objection to most dyeing processes that they tend to leave the hair in an abnormally dry, and consequently brittle, state. The oil shampoo, therefore, may be very usefully employed for the after-treatment of hair which has been bleached or dyed.

Diverse opinions have been expressed as to whether brilliantine should be applied to newly dyed hair or not. Gone are the days of antimacassars, so called because they were employed to protect upholstery from the macassar oil which was then so freely used. The reaction has tended to swing to the opposite extreme, resulting in a dislike of all preparations for the hair of an oily character. Moreover, some hairdressers are averse to applying brilliantine to hair that has just been dyed, because it darkens the colour, or, at any rate, makes it appear darker. This last objection, however, can be overcome by dyeing the hair a shade lighter than that actually required.

A more serious objection has been put forward, so far as dyes containing toxic substances are concerned, that the application of oil facilitates penetration of the epidermis by these bodies; an objection which can be obviated, firstly, by the avoidance of dyes which are really dangerous, and, secondly, by the thorough washing of the hair and scalp after dyeing, so that every trace of material which has not become firmly implanted in or on the hair, as an insoluble pigment, may be removed.

There can be no two opinions concerning the beneficial effects on the hair of a moderate use of oil. Defatting of the hair leaves it in a weakened condition. On the other hand, Dr. Leftwich found that treating the hair with castor oil definitely increased its strength. Liquid paraffin, B.P., had a similar, but rather less marked, effect.

Brilliantines are made from a variety of oils, including castor oil, olive oil, cotton seed oil, and liquid paraffin, of which the last is the one most frequently used. Sometimes alcohol is added. Castor oil is soluble in this liquid, the other oils are not, the addition of spirit to these producing the two-fluid type of brilliantine. A little colouring matter, usually alkanet root for red or chlorophyll for green, and perfume is also added. Brilliantines have also been made from glycerine, though this substance is not much employed nowadays for the purpose. It is most unsuitable, for not only does it make the hair sticky, but was found by Dr. Leftwich to exercise a weakening effect on certain types of hair.

In any case, the administration of an oil shampoo, effected by means of olive or castor oil, must be considered as superior to a simple application of brilliantine, the technique facilitating absorption of the oil by the hair and scalp.

THE METHOD OF OIL SHAMPOOING

As already explained, the oil employed should be olive, castor or some other high-grade vegetable oil, perfumed as may be desired. An additional reason for preferring vegetable to mineral oils is the relative ease with which the surplus can be removed after the massage.

The oil should always be used warm, as warming not only increases its penetrating power, but renders the treatment pleasanter. The warming may be effected by pouring the oil into a small china bowl, which is heated by placing it in a saucepan containing boiling water. Alternatively, a sprinkler bottle can be used, and the oil heated by placing the bottle in water which is gradually brought to the required temperature.

Before applying the oil, it is necessary to prepare the scalp by giving the hair a thorough brushing to remove particles of dead epidermis, dried sebum, etc. The oil can be applied immediately after this preliminary brushing ; but in order to render the scalp more receptive and to ensure a more effective treatment, it is advisable to apply two hot towels to the head, one after the other. These towels are prepared, by wringing out in hot water, in the same manner as for face massage. The first is wrapped round the head and pressed gently but closely to the scalp. The second is then applied in the same way, after which the application of the oil is made. It is important that no time should be lost in applying the oil when the second towel is removed, in order that full advantage of the scalp's extra receptivity produced by the moist warmth may be secured.

When the hot towels are employed, it will be found more effective to sprinkle the oil on the hair. When they are not used, the hair should be parted into small sections, the system of partings being similar to that advised in Chapter V. of the present Part in connection with bleaching ; after which the oil is applied with the tips of the fingers, or, better still, with a small but not too stiff brush. When the whole of the head has been treated, the oil is worked well into the skin by means of hand massage effected in the following manner :—

The position of the hands and fingers, a matter of considerable importance, is illustrated in Fig. 11. The fingers must be kept stiff, the tips only touching the skin, while the back of the hand is raised. The massage is effected by a rotatory movement of the fingers in *small* circles. There is a danger in the case of a head of long hair of getting the hair entangled unless the massage is carried out with the utmost care ; the fingers, therefore, should not be moved along the skin to another place, but taken off and put down again. The process is effected over the whole of the head and continued for a sufficient period of time to give the person being massaged a sensation of warmth all over the scalp.

FIG. 11.—THE OIL SHAMPOO.
Position of Fingers.

After this, the head is massaged by another process in which the tips of the fingers are drawn together as though they were picking up an object. This movement loosens the skin and renders it supple. Both forms of massage should begin at the forehead and end at the neck.

The two forms of massage, not only facilitate the penetration of the oil into the skin, but also promote a local hyperæmia, or increased supply of blood to the scalp.

The hand massage may be very usefully supplemented by mechanical massage applied by means of a vibrator apparatus,* a rubber-spiked " applicator " being employed. This is passed from the forehead to the neck, and must be pushed, not dragged, as otherwise it may get entangled in the hair.

The scalp having absorbed as much oil as possible, the hair is shampooed with hot water and a good " liquid soap," in order to remove every trace of unabsorbed oil. The hair must be thoroughly well rinsed with plenty of warm water and afterwards dried as far as possible with towels, as over-use of the mechanical dryer mars the efficacy of the treatment.

The oil shampoo is not only successful in restoring to hair its lost lustre and removing the lifeless appearance which is too frequently a concomitant of dyeing and bleaching, but it is effective as a cure for falling hair, when this is caused through excessive dryness of the scalp. To be wholly successful it is sometimes necessary for the oil shampoo treatment to be kept up for a period of two to three months, the shampoo being applied weekly or fortnightly.

---

* Some hairdressers prefer to supplement hand massage with " high-frequency treatment," using a vacuum-tube comb, concerning which it may be said that this treatment is sufficiently spectacular to impress the client with the idea that something very important is being done to him or her, and that usually it doesn't harm the hair !

CHAPTER IV

THE TECHNIQUE OF HAIR-DRYING

DRYING the hair would appear to be such a simple, ordinary operation as not to call for special consideration. To the hairdresser, to speak of the " technique " of hair-drying may, indeed, seem a form of professional heterodoxy. We trust, however, that he will not scorn to read this chapter. For, unfortunately, many hairdressers have only a superficial knowledge of the fundamental principles of the art of treating the hair, which principles are the same whether the treatment is for disease or for fashion, or, in other words, is a curative treatment or a form of beauty culture.

After the hair has been bleached or shampooed before and after dyeing, it is necessary to dry it. And drying means something more than merely removing the moisture in the shortest possible time without regard to the means used. There is a right way and a wrong way of drying the hair, and the use of the latter may, and often does, seriously mar the result of an artificial change in the colour of the hair, even though the actual bleaching or dyeing has been carried out strictly in accordance with all the other exacting rules of the hair-dyeing art.

SUNSHINE AS THE IDEAL HAIR-DRYER

Science is ever turning to Nature in order to discover so far as is possible how she works, and to enlist her aid in the treatment and cure of disease. Although drying the hair cannot be considered as a curative process, it is certainly one that should, so far as possible, be carried out on natural lines. To say that there is a right and a wrong way of drying the hair is to say that there is a *natural* and an *unnatural* way of doing it. The ideal form of hair-drying is, therefore, the one which most clearly approximates to Nature's way.

Sunshine is Mother Nature's drying and airing medium, and that sunshine is the ideal hair-dryer seems to be a scientific fact intuitively taken advantage of by a woman when drying her own hair. Does she not seek a sunny spot during the warm weather, where she can get both the warming rays of the sun and the accommodating and gentle summer breeze, rather than a gas fire or electric device giving a dry, hot air? It seems as though ages of experience have bred into her a knowledge of the fact that the sunshine is her hair's best friend. The direct rays of the sun shining upon her head penetrate through the moist hair right down to the scalp, causing a gentle relaxation and setting up a beneficial hyperæmia which sends nourishment to each sebaceous gland and hair papilla. The warm air, not arid enough to cause complete dehydration, dries the outside of each strand of hair and leaves the whole of it in that lustrous condition which no other agent can produce. Moreover, there is absolutely no danger of catching a chill or cold when the hair is dried by means of fresh warm air and sunshine.

Unfortunately, sunshine is not an agent that can be turned on and off at a moment's notice, though the possibility of producing artificially an exact equivalent to it raises some interesting questions to which we shall again refer. The hairdresser requires a means of drying hair with reasonable rapidity, and, to meet his needs, a large number of different types of gas and electric hair-dryers, mostly producing a current of hot air which is directed on to the head, have been devised and are extensively employed.

GAS AND ELECTRIC HAIR-DRYERS

The many types of hair-dryers referred to in the last paragraph may be roughly classified as follows :—

(1) Pedestal Dryers :—
  (*a*) Gas heated.
  (*b*) Combination—air gas-heated, but electrically propelled.
  (*c*) Electric—with flexible outlet tube.
  (*d*) Electric—helmet type.
  (*e*) Electric—employing hot air plus radiant heat.

(2) Portable, or Hand Dryers :—

(*a*) Electric.

(*b*) Combination—air gas-heated but electrically propelled.

The " Central Heating System " may be added as in a somewhat different category from any of the above types.

The first mechanical dryer which had any degree of success was the " Beyer," so called after the name of its inventor, and belonging to Class 1*a*. Its construction takes the form of a hollow metal cylinder, about 24 inches in height, mounted on an adjustable tripod. The heat is obtained by means of a gas-ring situated at the base of the cylinder, the top of the dryer being helmet-shaped, so as to fit over the client's head. The apparatus can be described as an ingenious form of gas oven. Although superseded to a considerable extent by various forms of electric dryers, a surprisingly large number of dryers of the " Beyer " type are still in use.

The combination pedestal dryer (Class 1*b*) marked an improvement upon the " Beyer," heating being effected, as in this latter type, by a gas-ring or large gas-burner. In addition, however, the apparatus is fitted with a small electric motor which propels a current of hot air mixed with the products of combustion on to the hair. This type of apparatus, which was of somewhat cumbersome construction, has been superseded by dryers of a purely electric type.

The electric pedestal dryer (Class 1*c*) is a type much employed to-day, and differs from the previously described types in two essential characters : The air is electrically heated and propelled, and is directed on to the hair by means of a large nozzle attached to a flexible tube held by the operator. This type of dryer has become more or less standardised and is usually constructed so that a neat metal case hides the electric propeller, a flex and plug being attached in order that the necessary connection can be made with the main. An electric heater is situated at the outlet, and to the outlet is attached a flexible tube. The whole apparatus is suitably supported on an adjustable tripod or pedestal. Considered as a hot-air dryer pure and simple, this type of apparatus is quite efficient.

The modern helmet pedestal dryer (Class 1*d*), somewhat resembles the type just described. The hot air, however, is not applied to the head by means of a nozzle attached to a flexible tube, but the whole of the hair is dried at once by means of a helmet. The adoption of this type of apparatus has been brought about as a result of the present practice of setting the hair in waves whilst wet. The flexible nozzle of the orthodox electric dryer is unsuitable for this purpose, as the sharp blast of air disturbs the waves. It was also necessary to adopt some device which would ensure an even heat for the whole of the head at one and the same time, in order that the drying might be uniform. This has resulted in the reintroduction of Beyer's original helmet idea with various improvements.

Many types of apparatus belonging to this class have been put on the market recently, the most satisfactory being those which provide means for the removal of the damp air produced during the course of drying. For example, in the " Icall Swift " model of Messrs. I. Calvete, Ltd., the mechanical construction of the helmet is such that the rapid down-draught of hot air produces a partial vacuum, with the result that the moist air is sucked up into the machine. In the " Fivminit " dryer of Messrs. Ajax, Ltd., the head is enclosed in the helmet by means of rubber buffers. The current of hot air enters the helmet through six tubes at the top of the head, and the damp air is drawn off through an outlet at the back of the neck.

Dryers making use of radiant heat (Class 1*e*) represent another innovation. These dryers are of the helmet type described above, the main current of hot air being produced, as in those of Class 1*d*, by means of electric heaters. In addition, an electric bulb with a carbon filament is fitted, which produces both light and radiant heat.

There are many forms of portable electric dryers (Class 2*a*) which are all similar in principle to the electric pedestal dryers (Class 1*c*) minus, however, the long nozzle and the pedestal. The air is electrically heated and propelled, the whole apparatus being made small and compact so that it may be held in the operator's hand, being connected to the main with a flexible wire. This type of dryer is both handy and efficient, being much used in these days of short hair.

The combination hand dryer (Class 2*b*) has been devised for use in saloons not connected with electric mains. The apparatus is fitted with an electric propeller driven by a small accumulator fixed at the back, and contains a small gas-heater, which is connected to the gas supply by means of flexible tubing.

In the " Central Heating System," heat and power are generated centrally, hot air being supplied under pressure to each cubicle, a flexible tube and switch in each compartment being the only indication of hair-drying mechanism. For large establishments, this system represents a big advance on the solo pedestal dryer, being more economical and avoiding the overheating of cubicles consequent upon the employment of an individually heated dryer in each.

THE DISADVANTAGES OF HOT-AIR DRYING

It is often too rashly assumed that any form of gas-heated or electric dryer is satisfactory providing it dries the hair rapidly, and, in the case of waved hair, does not disturb the waves. An examination of the matter, however, shows there to be many other questions involved, and that mechanical drying of the hair may be definitely injurious in its effects.

The hairdresser whose saloon is not attached to the electric mains is seriously handicapped, because *every form of gas-heated dryer must be regarded as unsatisfactory*. It is not surprising that operators after using dryers of this type feel fatigued, become listless, sag, and droop. They are suffering from the effects of poisoning, similar to that sometimes responsible for more serious results in bathrooms fitted with gas-heaters for the water not having proper outlets for the products of combustion of the gas. If a gas-heated hair-dryer were placed in a closed room and lit, it would be found, after a time, that the main bulk of the life-giving oxygen had been used up and replaced by carbon dioxide, accompanied by a proportion of deadly carbon monoxide, given off by the burning gas. And during hair-drying with an apparatus of this sort, the poisonous gases are breathed by both operator and client.

Electrically heated dryers do not, of course, suffer from this disadvantage ; but these, if improperly employed, may have a harmful effect upon the hair and scalp.

Let us consider the state of the hair whilst still wet after a shampoo. The liquid has penetrated the hair, leaving it in a softened, gelatinous condition ; and a quantity of the water used in rinsing clings to the outside of the hair and to the scalp. The customary mode of procedure is to remove the superfluous water by means of towels and as quickly as possible to get the mechanical dryer to work. The effect of the turning on of the hot air from the dryer is to cause a rapid evaporation of the liquid to take place. Now the rapid evaporation of a liquid under such circumstances as these is accompanied by a drop in its temperature. The effect on a sensitive scalp (and most scalps *are* sensitive after shampooing) is that it experiences a chill, which shuts off the blood supply. Every hairdresser will recall cases of clients who have inquired whether the hot air has been turned on or not; for, if the dryer is applied too early, the first sensation the scalp experiences is one of chilliness, even though the hot air be playing directly upon it.

If the hair completely dried by hot, dry air is examined, it looks uneven and lifeless, and feels harsh to the touch. It may be added that the superheated air and hot gases from a gas-heated dryer have an especially deleterious effect upon the appearance of the hair.

These effects are especially significant when drying dyed, bleached or permanently waved hair, which has already been robbed of its natural fat. This fact has been recognised for some time by hairdressers who really understand their business, and is the reason why many operators, when drying such hair, will not use mechanical dryers, but dry the hair *entirely by towelling*. There is much to be said in favour of this practice, our view being that the correct function of an electric dryer after a shampoo is to give the finishing touches to the work of drying the hair.

On the theory that sunlight is the ideal hair-dryer, the type of electric dryers making use of radiant heat have much to commend them, these being the nearest approximation so far produced to what might be called the natural method of drying the hair. It should be explained that sunlight owes its special effectiveness to the ultra-violet or actinic rays. These stimulate various forms of chemical reaction and are essential to most forms of life. In particular, the action of these rays on the scalp is to set up a mild hyperæmia, the hair thereby receiving additional nourishment from the increased blood supply. These rays, however, are entirely absorbed by ordinary glass, and therefore the small quantity of actinic rays produced in the radiant heat dryers are not made use of, the glass of the bulbs completely absorbing them. A special glass, " Vita " glass, is now manufactured which allows the ultra-violet rays to pass, and the curative value of these rays is now fully recognised. Electric bulbs made of " Vita " glass might be employed in conjunction with various types of radiant heat dryers, and a much better imitation of the heat and light in sunshine thereby obtained. There are also special types of lamps which produce these rays in much greater abundance than can be obtained with a carbon filament lamp of " Vita " glass. Such lamps, however, are only suitable for medical purposes ; for ultra-violet rays may be likened to powerful drugs which, highly beneficial in small doses, are poisonous in large ones, the use of these rays in large amounts being attended with a certain degree of danger.* It may be added that, under the London County Council (General Powers) Act of 1920, light, electric and other forms of treatment can only be given in London by persons licensed by the Council. Similar regulations are in operation in Manchester.

SOME PRACTICAL DETAILS

Having considered at some length the various types of hair-drying apparatus, and the advantages and disadvantages attached to each, we shall endeavour to indicate what we regard as the best practical method of hair-drying possible in the circumstances for use in connection with the shampooing which is a necessary concomitant of hair-dyeing.

As we have indicated, electrically heated dryers are much to be preferred to those heated by gas. When the hairdresser, not being connected to the main electric supply, is compelled

---

* For a full and interesting account of the medical uses of ultra-violet rays, see *Ultra-violet Rays in the Treatment and Cure of Disease*, by Percy Hall, M.R.C.S., L.R.C.P. (London, 1927). Recent research indicates that vitamin D (antirachitic) is formed as a result of the action of the rays on the traces of ergosterol associated with the cholesterol of the sebum.

to use gas for heating, the ventilation of the saloon must be especially studied, for, unless it is adequate, the air will soon become vitiated if much hair-drying takes place.

We consider it to be of fundamental importance that there should be the maximum amount of towelling or hand-drying. In effecting this, the fingers should be held in a claw-like fashion beneath the folded towel, as explained in the chapters on Shampooing. Drying the hair in this manner is calculated to produce an active hyperæmia, beneficial to both scalp and hair. The electrical dryer should only be brought into use to complete the drying ; and, when it is applied, the hair should be dried *in a direction away from the head.* The dryer should never be held towards the head as though it were a pistol speedily to dispatch the client to another world, as this manner of using it, not only produces the chill already referred to, but tends to plaster the hair on the head like a poultice. On the contrary, the hair should be gently lifted up with a stout comb, and the current of hot air directed *through* the hair strands and not on to the head itself. This method serves to dry the hair quickly and effectively, and obviates the chilling effects and consequent harm to which reference has already been made. These little points, when explained, may seem simple and obvious, but failure to observe them is too often the cause of an otherwise satisfactory piece of work being spoiled.

CHAPTER V

THE TECHNIQUE OF HAIR-BLEACHING

In Chapter II. of the previous Part, the theory of hair-bleaching has been fully dealt with, and our reasons have been stated for regarding hydrogen peroxide, which is the agent almost universally employed for this purpose, as in every way satisfactory. Hydrogen peroxide has been termed the " Queen of Decolorants," and the term is no mere hyperbole. Peroxide is easy to apply ; and, if properly used, harmless and practically infallible in its results. It is true that it has been subjected to a certain amount of criticism ; but it is safe to say that, in those cases where damage is done to the hair or an unpleasant colour produced, this is due to an immoderate use of the reagent, and especially to the employment in conjunction with it of excessive amounts of ammonia. Abuse of ammonia is a not uncommon failing, which must be carefully guarded against.

It might be said that the best plan would be to employ the weakest possible solutions of peroxide with the barest traces of ammonia over and above such amounts as might be needed to produce neutrality. Unfortunately this would render the process intolerably lengthy. The method we indicate below effects bleaching in the shortest possible time compatible with the use of solutions insufficiently strong to do damage.

PREPARATION OF THE BLEACHING MIXTURE

The peroxide employed should be of the best quality and of the strength sold as " 20 vols." Pure 0·880 ammonia should be employed in conjunction with it, the reagents being mixed in a saucer.

It is most important that the proper proportions of peroxide and ammonia are used. Too much ammonia damages the hair, produces red tints, and, with sensitive scalps, sometimes causes blisters on the skin. As we have just said, we are convinced that it is this which is nearly always the cause of unsatisfactory bleaching results. It is desirable, therefore, to keep the ammonia on the spare side; and, for all general purposes, it should never exceed more than 1 part by volume to 20 of the peroxide. This is, roughly, a teaspoonful of ammonia to a saucerful of peroxide—a method of measurement commonly adopted in the hairdressing trade. Teaspoons and saucers, however, vary in size, and in consequence a measuring glass should always be employed. If a flatter shade than the original is desired, the proportion of ammonia should be reduced to 1 to 30. Let us again repeat that abuse of ammonia, if it does nothing worse, will mar the beauty of the result.

PRELIMINARY CONSIDERATIONS

In the case of a man, or in that of a woman with a shingled head, it is not always necessary to shampoo the hair as a preliminary to bleaching, providing it is clean and dry. If the hair is long, however, it is generally necessary to shampoo it first of all. It is essential that the hair is thoroughly dry before the application is made, and any dampness should be removed by means of the dryer.

In all bleaching and dyeing operations it is necessary to consider the hair as being composed of three parts, as follows:—

(1) The Roots, or parts immediately above the scalp;
(2) The Lengths;
(3) The Ends or Points;

as shown in Fig. 12.

As a result of constant washing, brushing and general wear and tear, the lengths are weaker and offer less resistance to the action of a dyeing or bleaching agent than do the roots, whilst the points are weaker still, this, of course, being especially the case with long hair. If no allowance was to be made for these differences in resistance, a result would be obtained of a very unsatisfactory and uneven character. In the case of hair-bleaching, there are two methods of overcoming the difficulty, namely, the method of timing and that of dilution, the rationale of which will be understood from the following brief description:—

PLATE VII.

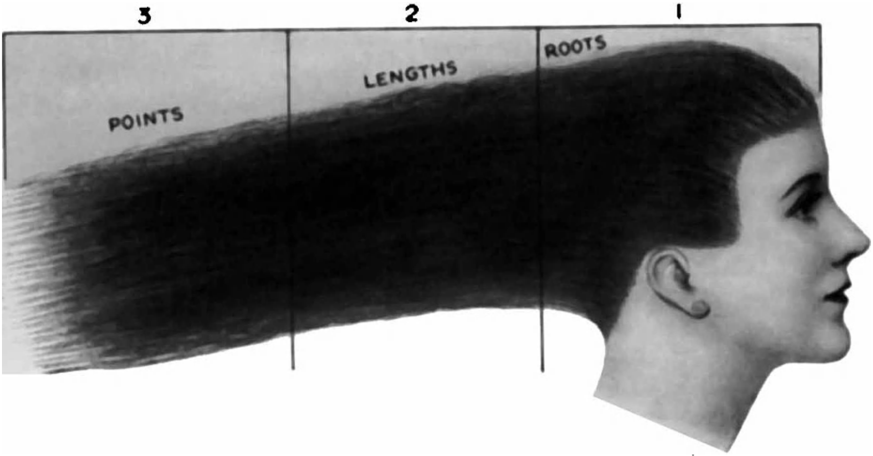


FIG. 12.—ROOTS, LENGTHS and POINTS of the Hair.

[*To face p.* 122.

(*a*) *The Timing Method.*—The peroxide is first applied to the roots (Fig. 12, Section 1); after a few minutes to the lengths (Fig. 12, Section 2); and, finally, after a few more minutes, to the points (Fig. 12, Section 3).

(*b*) *The Dilution Method.*—The peroxide is applied first of all to the roots; it is then diluted with a little distilled water and applied to the lengths; and, after being still further diluted, it is applied to the points.

We consider method (*b*) to be preferable, as it ensures proper shading.

It should be added that shingled hair or hair cut short in any other manner cannot be considered as consisting of three sections. From the practical point of view such hair is best regarded as consisting simply of roots and lengths and treated accordingly. Careful judgment is necessary on the question of roots and lengths, the common sense of the operator playing an important part in the matter.

METHOD OF APPLICATION: DIVIDING AND THROWING THE HAIR

The question of the best way of dividing the hair so that each hair may receive its correct amount of peroxide is one of great importance. The secret of successful bleaching lies in the adoption of a correct technique of division. The method described below is one based upon long trade experience and should be strictly followed.

It is essential that the actual work of bleaching *is started at the back of the head.* The hair is first divided from the forehead to the nape of the neck, the portion on the left being held in the left hand, as shown in Fig. 13. With a piece of cotton wool, the peroxide is dabbed along this parting, the operation commencing at the crown and finishing at the nape of the neck.

With one sweeping movement of the comb, the hair is then parted from the crown about ¾ to 1 inch *to the left of the first parting.* The peroxide is applied to this parting, the application being commenced at a point about ½ inch to the left of the crown, in order not to go over old ground again. The hair is again parted in a similar manner, the parting starting about

½ inch above the crown and extending to about ¾ to 1 inch to the left of the former parting, and the peroxide is applied as in the case of the previous parting. This process is continued until the left front is reached; this is parting No. 10 in Figs. 14 and 15, in which the system of partings is clearly shown.

In the case of long hair it is necessary, as each parting is completed, for the operator to take the piece of hair from the left hand and to throw it over to the right, keeping it as far as possible on the top of the head. In the case of short hair, each piece can be laid in order on the right side.

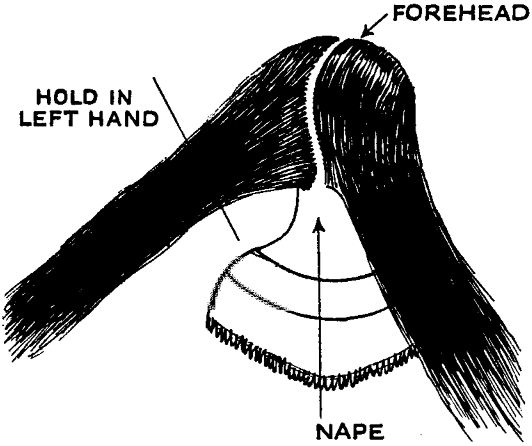


FIG. 13.—HAIR-BLEACHING.
Dividing the Hair.

The left half of the head of hair will now be thoroughly impregnated with peroxide at the roots. This portion of the hair is then assembled in a chignon and the work effected on the right half of the head in a similar manner. This is commenced at parting No. 11 in Fig. 14, each section of the hair, as impregnated, being thrown into the left hand until the final parting, No. 19, is reached.

The whole of the hair is now impregnated at the roots. In the case of long hair, the peroxide is diluted and the lengths are treated. These need only be divided four or five times for each half of the head, instead of ten times as in the case of the roots.

The peroxide is then still more diluted and the points are treated, being divided into two or three sections according to the thickness of the hair.

In the case of short hair, after the roots have been impregnated, the peroxide should be just slightly diluted and the rest of the hair treated.

If the hair is extra short, as in the case of an Eton crop, very severe shingle or a man's cut, only one application is necessary, after which the cotton wool is run lightly over the head to ensure that the whole of the hair is impregnated.

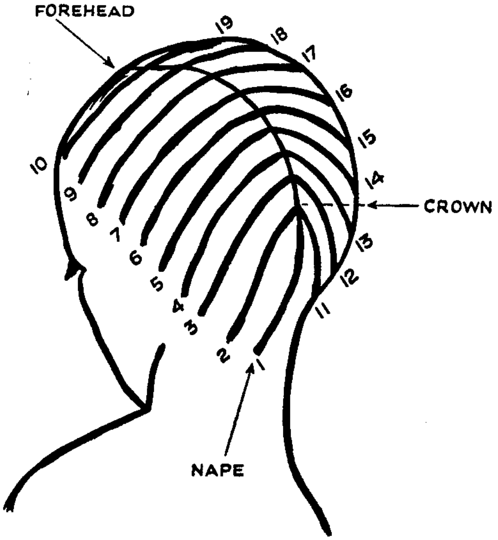


FIG. 14.—HAIR-BLEACHING.
System of Partings (Back view).

There is some divergence of opinion as to whether cotton wool or a brush is the better medium for applying the peroxide. Practical experience, however, indicates that cotton wool is preferable, as by this means a more even distribution of the mixture of peroxide and ammonia is effected. If, however, a brush is favoured, we strongly recommend that it is used not for the roots, but only for the lengths and points.

The method of application just described should take from six to fifteen minutes according to the thickness and texture of the hair. It is less easy to state a definite time for the bleaching to be effected, as this depends upon many factors, including the texture of the hair, its original colour, and the final tone desired. It may vary from ten to forty minutes. If desired, the necessary length of time can be determined by a preliminary experiment on a piece of hair cut from the head ; but in any case it is desirable for a watchful eye to be kept on the progress of the bleach, the hair being carefully examined at the end of each ten minutes.

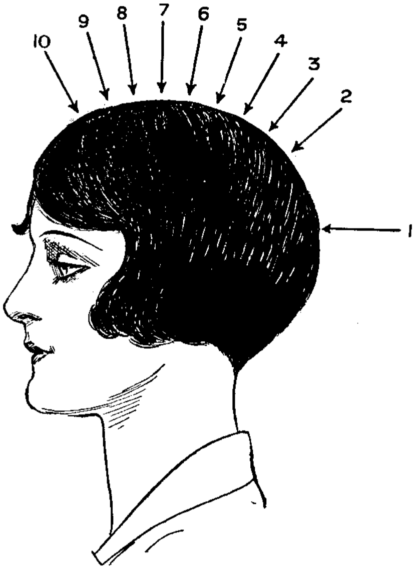


FIG. 15.—HAIR-BLEACHING.
System of Partings (Side view).

It is not necessary to shampoo the head after bleaching with peroxide and ammonia, as these reagents are not toxic. The hair, however, must be thoroughly dried. This should not be done vigorously as after a shampoo. The better plan is to remove all superfluous moisture by a towel pressed lightly over the head, the drying being afterwards *gradually* completed by the aid of an electric dryer. The hair should be continually combed during this latter process.

We advise readers desiring to carry out hair-bleaching professionally to get the method described of dividing the hair thoroughly fixed in their minds, as this method is of fundamental importance, being employed not only in bleaching, but also in applying other liquids (*e.g.*, liquid dyes) to the hair. Without a systematic method of division, not only is there wastage of time, but grave danger of parts of the hair being missed, and of the hair becoming tangled into the bargain.

RETOUCHING BLEACHED HAIR

The method of application so far outlined has been that appropriate in the case of " full " or complete bleaching, that is to say, when the whole of the hair has to be treated.

After the hair has grown and another bleaching become due, it is not always necessary to bleach the whole head of hair. Usually only that section of the hair we have distinguished as the roots, which is newly grown and dark, needs attention.

Partial bleaching is an exacting process calling for much skill on the part of the operator. If, however, the system of partings described above is used, the operation becomes a relatively simple one, as this system is excellent for exposing the dark roots of the hair which alone need treating with the peroxide. So far, therefore, as the method of dividing and throwing the hair is concerned, the technique of bleaching is the same whether the treatment required is complete or partial.

In the case of retouching, it is important to prevent the peroxide from running on to the previously bleached hair, as otherwise uneven results will be obtained. An effective plan is to apply a slight touch of brilliantine to the previously bleached lengths, or, what is perhaps better, to use a little non-medicated " liquid soap," the application being best effected with a brush. It is not necessary for the oil or soap to be applied to the whole of the lengths and points, but only to that portion of the lengths immediately following on to the roots requiring to be bleached. This expedient will be found very useful to prevent peroxide running ; but, in adopting it, care should be taken to use the oil or soap sparingly.

CHAPTER VI

PRACTICAL PRELIMINARIES TO HAIR-DYEING

THE days of the barber-surgeon are long past ; but amongst modern hairdressers there are those who seek to uplift the profession of hairdressing so that it may occupy a position similar to that now held by the medical profession. Certainly this is a tendency to be encouraged ; and it may be said that there are points where the two professions must approximate, this being especially true as concerns the preliminary diagnosis necessary before a head of hair is successfully dyed.

Before dyeing is attempted, either with a liquid or paste dye (*e.g.*, " henna "), the head must be thoroughly examined in order to make certain that the scalp is in a completely healthy condition ; for it is obvious that the application of substances, harmless to a normal head, might produce very disastrous results on one affected by disease. If, therefore, any form of eczema or dermatitis is present, or there are eruptions, pimples, boils or any signs of skin disease, however mild in form, dyeing of the hair should not be attempted ; and the hairdresser asked to dye hair on a head of this character ought to inform the client that the dyeing cannot take place until the disease has been cured. Moreover, as we have indicated in Chapter XIV. of Part II., the majority of dyes, whilst containing toxic substances, are not really dangerous if used with care. This care necessitates that such dyes shall not be employed, even on a perfectly healthy head, if there are any cuts or abrasions present. In cases coming under this category, the dyeing must be deferred until the cuts or abrasions are completely healed, and all signs of them have disappeared.

If, moreover, in spite of our advice to the contrary, the use of a dye containing paraphenylene-diamine or any other diamine or amino-phenol is contemplated, an indispensable condition is the application of the Sabourard-Rousseau test immediately, that is to say, not more than a few days, before the application.

THE SABOURARD-ROUSSEAU TEST

This test is usually recommended by the various firms manufacturing hair dyes based on para and allied substances. It may be observed, however, that application of the test itself has been known to give rise to distressing symptoms in persons specially predisposed to para poisoning. The test is carried out as follows :—

A small patch of skin just behind the ear of the person on whom the test is to be made is cleansed with soap and water, followed by an application of weak alcohol, *e.g.*, Eau de Cologne. A small quantity of the para dye plus the oxidant to be used with it is then applied. In the case of proprietory para dyes, the materials are usually supplied packed in two bottles, labelled respectively " A " and " B," the dye containing para being in bottle " A," and the oxidant in bottle " B." For the purposes of the Sabourard-Rousseau test, equal quantities of these two liquids, say 1 c.c. of each, are mixed and applied with cotton wool. After a few minutes, when the mixture has dried on the skin, the patch is covered with collodion applied by means of a camel-hair brush. This rapidly dries, leaving a thin film, which acts as a protective covering to the patch whilst the oxidation of the para is proceeding. After the expiration of not less than twelve and preferably twenty-four hours, the film of collodion is peeled off and the patch of skin washed with soap and water. If the person has experienced no irritation and the patch shows no sign of redness or inflammation, it may be concluded that no predisposition to para poisoning exists and that dyeing may be safely proceeded with. At any rate, that is the position taken by firms interested in the manufacture of para dyes ; but to be really certain it is perhaps advisable to carry out a further test. For example, some of the leading hairdressers of France, whose experience in hair-dyeing is exceptional, advocate further application of the test to a patch of skin over the large vein (median-basilic) inside the bend of the elbow and/or to a patch over the large vein (internal-saphena) on the inside of the thigh. Cases have been known where a negative result has been given by the skin behind the ear, but a positive result when the test has been applied in one or other of the additional places mentioned above.

Dyeing should never be proceeded with *if any positive results whatever are given by the tests.* Moreover, it must be emphasised that the test should always be applied as a matter or routine in every case where the use of para dyes is contemplated, irrespective of the fact that a dye of this character may have been used on the same person previously without harmful results. This is very important, as cases have occurred of persons, at one time not showing a predisposition, developing it later on.

SYMPTOMS AND TREATMENT OF HAIR-DYE POISONING

It may be useful before proceeding further with the discussion of the practical problems of hair-dyeing, briefly to outline the symptoms that have occurred as the result of para poisoning.

The first sign is the appearance of a rash of small pimples, followed by an unsupportable itching and a kind of eczema. The skin develops a violet-red colour and becomes damp and oozing, there being much inflammation. Later on, swellings appear underneath the eyes and eyelids. Indeed, the entire head and face frequently become swollen, the patient appearing to have difficulty in opening the eyes.

The forehead is often burned and the neck covered with red patches. In bad cases, the lips are red and thickened, and sometimes the interior of the mouth is swollen. These symptoms are accompanied by violent headaches, shiverings, and a rise in the temperature. The swelling may even extend to the legs and feet.

Cerbelaud (*Formulaire des principales spécialités de parfumerie et de pharmacie*) recommends the following treatment:—

A purgative containing 50 grams of sodium sulphate (Glauber's salts) or magnesium sulphate (Epsom salts) is administered to the exclusion of all other purgatives. The mouth is frequently washed out with Vichy water, not more than one glass being drunk, in order not to tire the kidneys, which are much irritated by the poison. The next day, nothing should be eaten, and only distilled water or Evian water (a flat, natural table water) containing 10 per cent. of powdered lactose (milk sugar) should be drunk.

It is quite obvious, however, that anyone poisoned as a result of using a para dye should not rely upon home treatment, but *immediately seek the best possible medical advice.*

EXAMINATION OF THE HAIR-SHAFT : PREVIOUSLY BLEACHED AND DYED HAIR

Whilst the condition of the scalp will determine whether dyeing can safely be undertaken or not, that of the hair-shaft itself plays a big part in determining the success or otherwise of the result of the dyeing from an æsthetic point of view. In addition to the scalp, therefore, a careful examination of the hair must be made, in order to find out whether this is " damaged," that is to say, shows signs of breaking anywhere or splitting at the ends. The ideal method is to make a microscopical examination ; but an experienced operator ought to be able to detect with the naked eye such signs in the hair, provided the examination is made in a good light. When the hair is " damaged," it is only fair for hairdressers to warn clients that dyeing may possibly further damage the already weakened hair-shaft. The best plan, when the hair is brittle or shows signs of splitting or breaking, is to treat it with the oil-shampoo over a period of three months prior to undertaking the colour-change * ; and this treatment is also advised in specific cases where the scalp, whilst free from disease, is in an abnormally dry condition.

It is also advisable when the hair is falling in an unusual degree, or there exists evidence of alopecia areata, not to attempt dyeing until the hair has been restored to health.

A further and very important consideration is the question : Has the hair been bleached or dyed before ? From the point of view of hair-dyeing, heads can be classified into three classes : (*a*) the " virgin " head, that is to say, one the hair of which has never been previously bleached or dyed ; (*b*) the

---

* Split hair may first be singed, this process providing an effective means for removing the frayed points.

head of hair which has been bleached ; and (*c*) that which has been dyed before, either partially or wholly.

All that has been said already concerning the examination of the head and scalp, and necessary treatment preliminary to hair-dyeing, applies to all three types of head, the " virgin," the bleached and the previously dyed ; but, in addition, the latter types present problems of their own.

In dealing with a head of bleached hair, it has to be borne in mind that such hair is more receptive towards certain dyes (for example, those based on para and allied substances, rasticks and compound hennas) than virgin hair ; or, as it is rather loosely said, bleached hair offers less resistance. In these cases, the use of a diluted dye is indicated, or one normally giving a lighter shade than that actually required. The reason for this peculiarity is obscure, and a so-called explanation which has been put forward based on the supposedly destructive action of hydrogen peroxide on the cuticle must be rejected. It is conceivable that the phenomenon may be due to interaction between the oxidised natural pigment of the hair and the dye, the former being regenerated and the oxidation of the latter facilitated in consequence.

Dyed hair can rarely be successfully recoloured with any dye other than the one previously used. Very often, however, the use of the latter is neither possible nor desirable. For example, there are many cases where a particular dye has been found unsatisfactory, having produced an undesired, or even abnormal, colour, such as green. Alternatively, the colour may be of a patchy character, or, whether as a result of fashion's dictates or not, a different colour may be desired. The problem, therefore, presents itself of how best to remove old dyes from the hair, this being an essential preliminary to the application of new ones.

REMOVAL OF DYES FROM THE HAIR

The problem of satisfactorily removing dyes from the hair is a far more difficult one than might be gathered from much that has been written on the subject previously. In some cases, indeed, the chemical reactions necessary to remove the pigments artificially deposited in or on the hair are of so violent a character as seriously to damage the hair itself. For example, sodium mono-sulphide has been recommended as a decolorant in certain cases : but this reagent is much better for removing the hair itself than for removing a dye from it ! Some particulars of the most useful decolorants have been given in Chapter II. of the previous Part, and, as there pointed out, when the exact chemical composition of the old dye is not known (which is, of course, usually the case) preliminary experimentation is essential on a piece of hair cut preferably from behind the ear.

By far the best decolorant for the majority of dyes is hydrogen peroxide, activated by ammonia, in the proportion of 1 part of 0·880 ammonia to 20 to 30 parts of hydrogen peroxide of 20 vols. strength. This will usually be found effective for removing the colour produced by para and allied dyes, and in many other cases as well. The only disadvantage attaching to hydrogen peroxide and ammonia is that when they are used to excess, as may be necessary when removing a stubborn dye, the hair is rendered very dry and consequently brittle, a state of affairs best remedied by means of the oil-shampoo.

In cases of metallic dyes, where hydrogen peroxide has not been found effective, a 5 per cent. solution of sodium thiosulphate, activated by the addition of not more than 2 per cent. of concentrated sulphuric acid,* may be found useful. Another decolorant which is sometimes effective, more especially in the case of hair dyed by rasticks and other dyes containing iron, is a solution of oxalic acid in water, containing not more than 4 per cent. of the acid. This substance, however, must be used with great care owing to its poisonous character and its rather harsh action on the hair. In some cases treatment with sodium thiosulphate followed by that with oxalic acid will be found effective.

Having discovered a satisfactory decolorant for a particular dye, the best method of application is as follows :—

The hair is first thoroughly saturated with the solution, being treated section by section in the manner described in the chapter on " The Technique of Hair Bleaching." Small wads of

---

* See warning on p. 23.

cotton wool should be used for the application, in preference to a brush, and the operator is advised to wear rubber gloves—at a pinch, a pair of old kid gloves may be used. This precaution is especially necessary when a para dye is being removed.

It will be necessary to leave the decolorant on the hair from ten to fifteen minutes. The preliminary experiments will have given some indication as to the exact time ; nevertheless, it is desirable that the hair should be carefully examined at intervals of five minutes or less, in order that the action of the decolorant may be carefully noted.

After the expiration of the necessary time, the decolorant is squeezed out of the hair. This is effected by the operator taking the hair section by section. Each section in turn is wrapped about with a rough towel held between the thumb and fingers, and the liquid squeezed out by passing the thumb sharply over the fingers.

The hair is then thoroughly shampooed with warm water and a non-medicated soap. It is well rinsed and dryed as far as possible with towels as recommended in the chapter on " The Technique of Hair Drying."

If the decoloration is incomplete, it may be necessary to repeat the whole operation. It is, however, advisable to allow several hours to elapse before attempting the second treatment.

Decoloration usually leaves the hair in an abnormal state, and after decoloration and previous to a fresh application of a hair dye it will be found a very good plan to give the hair at least two oil-shampoos, some time being allowed to elapse between the last of these and the dyeing operation itself, as otherwise the oil would tend to inhibit the action of the dye. It should be noted that hair which has been subjected to decoloration is usually very receptive to dyes subsequently applied, and, therefore, it is important in making a fresh application to use a considerably weaker dye than would be employed in the case of a virgin head.

CHAPTER VII

THE TECHNIQUE OF APPLYING LIQUID DYES

FROM the point of view of application, hair-dyes fall into two distinct classes : (*a*) liquid dyes, and (*b*) dyes applied in pack form, usually containing henna. The use of the latter necessitates a very special technique, which will be dealt with in the next chapter. In this chapter we are concerned purely with liquid dyes.

Liquid dyes fall roughly into three classes, namely :—

(*a*) One-solution progressive dyes.
(*b*) One-solution instantaneous dyes.
(*c*) Two- or three-solution instantaneous dyes.

The progressive dyes produce the colour gradually, that is to say, they require several applications before the desired colour is fully developed. As has been pointed out in Chapter IV. of Part II., the majority of the so-called " hair-restorers " belong to this class, being progressive dyes based on lead. Such dyes are nowadays little if at all employed by hairdressers, but are put up and sold for home usage. The term " progressive " is also sometimes applied to dyes which, whilst only requiring one application, do not produce the colour immediately, this only being developed after the course of a few hours as a result of the action of the oxygen of the air. Speaking generally, rasticks belong to this type.

Instantaneous dyes, on the other hand, are preparations which produce the desired colour immediately, or very shortly, after application. Amongst the most important of these dyes may be mentioned those based on para and allied substances, and dyes containing silver and other metals. The para dyes belong to the class of one-solution dyes, because, although two liquids are employed, one containing the dye and the other the oxidant (generally hydrogen peroxide), these two liquids are usually mixed immediately before application, so that only one solution is actually applied to the hair. On the other hand, in the case of the two- or three-solution metallic dyes, two or three applications of different liquids have to be made. The best plan in this case, as we have already pointed out, is *to apply the liquid containing the metallic salt or salts first*. This is then followed by an application of the second solution containing pyrogallol or an alkaline sulphide. If the former is employed, a final application may be made of a third solution containing an alkaline sulphide.

The actual method of applying the liquid to the hair is the same whatever type of liquid dye is employed. If, however, an instantaneous dye is chosen, it is essential that the solution or solutions selected are of such a nature as to produce the required colour, for if the colour formed is darker than that desired it may be difficult to remedy the defect. This consideration, of course, is not of the same importance when employing a progressive dye which only produces the full colour after several applications. On the other hand, it is of extreme importance when a two- or three-solution dye is used ; because, whilst treatment with the first solution effects very little visible change in the colour of the hair, if this solution is too strong or is *allowed to remain on the head for too great a length of time*, the application of the second solution may cause the development of a colour much darker than that desired. Indeed, careless use of such dyes often results in producing a sort of ashy grey. When a two- or three-solution dye is employed, we recommend the practice of gently rinsing the hair and drying it after each application, before the next one is made. The drying is essential to obtain good results.

CHOICE OF DYE TO PRODUCE REQUIRED COLOUR

Hairdressers who prepare their own dyes, using the formulæ given in Part II. of this book, or other formulæ, will find it a good plan to keep a few stock-solutions made up to give such standard colours as blonde, red, ash-brown and black, which can be mixed in varying proportions to produce intermediate shades, it being understood that only dyes based on the same or similar ingredients can be so blended together.

In the case of proprietory dyes, these are usually made up to produce a large number of shades, the shade specified being that which the dye produces when applied to *white hair*, a matter most important to bear in mind when the dyes are being used on hair of any other shade. Satisfactory results cannot be obtained by blind adherence to the labels on the bottles. In addition to the allowance that must be made for the fact that the colours stated refer to those produced on white hair, it has to be borne in mind that the hair of different persons varies very much in texture, and, consequently, in the resistance it offers to a dye.

Hair may be weak owing to some inherent peculiarity or it may be abnormally receptive to certain dyes as the result of bleaching ; and, as we have pointed out in the last chapter, dyed hair is almost invariably rendered highly receptive as a result of decoloration.

It is sometimes possible to detect a weakened texture by feeling the hair with the fingers. This method, however, must not be relied upon, as enhanced receptivity is by no means always the result of weakness. Before hair is dyed with any preparation, other than with a progressive dye needing several applications to give the requisite colour, *a preliminary test must be made on a piece of hair cut from behind the ear or between the ear and the nape of the neck, and defatted by means of soap and water.* When the hair exhibits weakness or abnormal receptivity from whatever cause, this can be counteracted either by diluting the dye made up to give the required shade on normal hair, or by using a dye normally producing a lighter shade.

As a general rule, it is inadvisable to dye hair a colour which differs from the natural colour by more than two shades ; and hairdressers are well advised to persuade clients to keep within this limit, otherwise the disharmony produced between the dyed hair and the colour of the eyes and that of the skin is apt to prove unpleasing. Clients frequently desire very dark shades. In such cases, it is better for the hairdresser to err on the light side than on the dark. If the result is not quite satisfactory, it is much simpler to darken the hair than to be compelled to resort to decoloration.

As indicated previously, and as, indeed, should be obvious, dark hair cannot be satisfactorily dyed a lighter shade. In every case, therefore, where a lighter colour than the original is desired, resort must be made to preliminary bleaching.

The case of a head containing grey hair mixed with hair of another colour, in which it is desired to dye the grey hair the original colour, is a very common one. If a dye is applied which will produce the right colour in the case of the grey hair, this dye will tend to darken the naturally coloured hair. To overcome this difficulty, the naturally coloured hair must be first lightened two or more tones below the colour desired. This is effected by a preliminary bleaching with hydrogen peroxide activated by means of a very little ammonia, a ten minutes' application being generally sufficient to effect the slight bleaching required.

METHOD OF APPLICATION

As we have explained in previous chapters, very few dyes give satisfactory results with hair that has not been defatted, and the first operation preliminary to applying the dye is, therefore, a good shampoo, after which the hair must be carefully dried.

Many of the liquid dyes stain the skin, and sometimes, as in the case of stains produced by silver, these are not very easy to remove, especially when they are produced in places where the skin is soft and sensitive. It is necessary, therefore, to protect the neck, ears and forehead of the person whose hair is being dyed during the operation. This can be done by a light application of pure soft soap, vaseline or brilliantine, so as to form a thin film over the parts in question, care being taken to prevent any of this material coming into contact with the hair itself. And whilst stains on the hand are of a less serious character, being more easy to remove, operators are well advised to wear rubber gloves, a precaution absolutely essential if a dye based on para or any similarly toxic body is employed.

To ensure complete impregnation of the whole of the hair, the application of the liquid must be made in a systematic manner, the best system being that we have outlined in Chapter V. of the present Part in connection with bleaching, where the technique of dividing, parting and throwing the hair is described. What has been there said concerning the different treatment required by the roots, lengths and points when hair is being bleached, applies with equal force in the case of dyeing; and either method there described for allowing for the different resistances of these three sections of the hair may be adopted.

In dyeing hair, this question of the different resistances of the roots, lengths and points is one of great importance. If no allowance at all is made for these differences in resistance, the resulting colour will be lightest at the roots and darkest at the points. The natural colour of hair, however, tends to shade in the opposite direction, appearing a little darker at the roots than at the points.

For applying dyes, brushes are usually employed. We consider a brush of a similar pattern to a tooth-brush, but somewhat larger, to be better than one of the paint brush type, though both forms are in use. Suitable brushes are supplied by most reputable hairdressers' and chemists' sundriesmen.

Even distribution of the liquid—and even distribution is most important—can be obtained by the use of a fine comb.*

In the case of two-solution dyes, the first liquid must be allowed to remain on the hair the *exact* time indicated by preliminary experiment and lightly rinsed off with tepid water, after which the hair is carefully dried and the application of the second solution made.

One-solution instantaneous dyes based on para and allied substances usually take about ten minutes for the colour to develop; and, in the case of these, the time can best be judged by observation of the head itself.

After hair has been dyed, it is essential thoroughly to shampoo it with soap and water,† in order to remove all soluble matter. In no case should the shampooing be delayed more than one hour after dyeing. *Failure to carry out this precautionary*

---

* The best material for combs is tortoise-shell; but, unfortunately, the high price of this material to a large extent prohibits its use. Failing tortoise-shell, a vulcanite comb should be employed. Horn is inadvisable, as it tends to lacerate the hair. Metal combs must not be used for hair-dyeing, owing to the possibility of a chemical reaction between the comb and the dye.

† A dry shampoo is useless in this connection.

measure has been responsible for many of the accidents which have happened in connection with hair-dyeing.

After the shampoo, the hair is dried, towelling being adopted for the purpose as far as possible, for reasons already pointed out in a previous chapter.

The question of whether brilliantine should be finally applied or not after hair has been dyed has been discussed in the chapter on " The Technique of the Oil Shampoo."

RETOUCHING

A most important branch of the art of hair-dyeing is the process of retouching. Assuming that a suitable dye has been selected and the work of dyeing the hair satisfactorily carried out as described above, the hair can be regarded as permanently dyed, that is to say, the colour has been (more or less) permanently attached to the portion of the hair projecting above the scalp at the time the application was made.

As, however, is well known, the hair is subject to growth, and, as pointed out in Part I., this growth is effected by the addition of new cells at the base of the hair, which is, in consequence, pushed up further out of the follicle. For example, grey hair which has been dyed brown, whilst continuing to be brown so far as the lengths and points are concerned, will show grey at the roots, where the hair is new, the former roots having now become lengths.

The various estimates which have been made of the average life of the normal scalp hair, as mentioned in Part I., differ very much from one another. According to some authorities, the whole of the hair of the scalp is renewed in the course of about three years ; though in these days of short hair, probably a lower figure would be nearer the mark. The more important factor from the point of view of hair-dyeing is the rate of growth. This averages about $\frac{1}{3}$ to $\frac{1}{2}$ inch per month ; so that a person with completely dyed hair will, usually speaking, need $\frac{1}{2}$ inch retouched every four to six weeks.

The retouching presents relatively little difficulty providing exactly the same dye can be used for the process as was originally applied. The wisdom of keeping a log book or record of dyeing cases should be obvious to every hairdresser ; for if this plan is adopted, he only has to turn to the book, when a retouching is due, in order to be informed of the details of the treatment necessary. When the hairdresser is called upon to retouch hair that has been dyed by some one other than himself, it is important, before attempting the job, to find out the nature of the dye previously applied and whether the hair has been bleached or not, for dyed hair cannot be satisfactorily retouched with a dye of a different nature from that originally employed. The client may be able to give the required information ; but, owing to the general state of ignorance concerning the composition of hair-dyes and the mystification practised by many manufacturers, this information may not be forthcoming, or, if given, may be inaccurate. It is very desirable, therefore, to make a preliminary test on an area well hidden, or preferably upon a few hairs removed from the scalp.

In every case of retouching with a para or allied dye, it is essential to apply the Sabourard-Rousseau test *each time* before the retouch is made.

The chief difficulty in making a retouch is the preventing of the new dye from overlapping on to the previously dyed hair. The overcoming of this difficulty renders retouching an exacting process demanding considerable skill on the part of the operator.

In cases where bleaching of the new roots is necessary, it is particularly important for extreme care to be taken to ensure that the peroxide does not run on to the previously dyed hair. In order to prevent this, the dyed hair next to that which is to be bleached should be lightly touched with brilliantine or non-medicated soap, before the bleaching solution is applied to the roots, soft soap being recommended in preference to brilliantine in cases where the hair is dyed a light shade.

The following method of retouching is recommended as being the most effective :—

(1) The dye is applied with a brush of the type previously mentioned lightly dipped in the solution. A light touch is here, as throughout the whole process, very essential.

(2) The application is commenced close to the scalp, the

same system of partings and divisions being used as for the whole head.

(3) The new dye is not applied right up to the line of the previous dye, but a very small gap is left between.

(4) When the entire roots have been impregnated, the small gaps left between the old and new applications are bridged by combing the roots of the hair with a comb * dipped in water, the whole system of partings being recommenced for this purpose.

For a really effective result, it is imperative that the work be done as quickly as possible.

Should any of the new dye, despite the precautions taken, run on to the previously dyed hair, it is recommended that the hair be gone over with a wad of cotton wool, slightly dampened with water, with which the unwanted dye is carefully wiped off.

After the colour of the new dye has developed, the hair is thoroughly shampooed, just as if it had been completely dyed, and carefully dried in the manner previously described.

---

* See footnote on p. 139.

CHAPTER VIII

THE TECHNIQUE OF HENNA DYEING

IN Chapter X. of Part II. brief reference has been made to the history of henna as a hair-dye, its introduction into Western Europe, and its great popularity at the present time, almost justifying the use of the term " henna cult."

As we have explained, henna is much employed in shampoo powders and hair washes as a colour-tonic. In this chapter, what we are concerned with is the use of henna, either pure or mixed with other substances, as a hair-dye, for which purpose it has to be used in paste form, and a special technique is required. Before proceeding to a description of the actual method of application, one or two preliminary matters call for attention, including a reminder of the fact that, since henna rasticks contain pyrogallol, these must not be employed in any of the cases specified in Chapter VI. of the present Part where the use of this substance is attended with danger.

CHOICE OF DYE TO PRODUCE REQUIRED COLOUR

Speaking generally, what has been said in the previous chapter regarding choice of dye to produce the required colour applies in the case of henna dyes. A few special remarks relative to these, however, may not be out of place. In the majority of cases, the hairdresser will be presented with the problem of dyeing hair which is more or less grey a colour as near as possible to that of the original. Concerning this colour, the colour of the hair at the roots will be found the best guide. Preliminary bleaching in a case such as this is not usually necessary ; but whether proprietary compound hennas are used, or henna dyes made up by the hairdresser himself to colour white hair specified shades, in choosing from these, careful allowance must be made for the percentage of grey hair in the head.

When the amount of grey hair present is 15 per cent. or less, a dye giving two shades lighter than the one desired should be used; for example, if a mid-brown shade is required, a blonde dye is employed, which will tint the white hair blonde without darkening the remainder. If 15 to 30 per cent. of the hair is grey, a dye one shade lighter than the required colour is used, for example, a brown dye to produce dark brown. If 30 to 75 per cent. of the hair is grey the dye used is the one giving the shade required. In cases where the percentage of grey hair exceeds 75 per cent., it may be desirable to leave the paste on a little longer than is indicated in the Table given below.

As we have just said, it is not usually necessary to bleach grey hair before dyeing it with henna. When, however, a lighter shade than that of the natural growth is required, preliminary bleaching becomes essential. For example, a person with dark or black hair intermingled with white might wish to have it dyed brown. This could be done by first bleaching the dark hair before applying the dye. Coarse hair is sometimes found to be very resistant to henna; but its receptivity may be enhanced by bleaching, the best way of dyeing such coarse hair black being ten minutes' bleaching followed by a shampoo and an application of a brown or dark brown compound henna. Bleaching is also recommended for grey hair showing a yellow to rusty discoloration, popularly called "acid" hair.

Bleached hair is more receptive towards compound hennas than virgin hair, and in dealing with hair of this character a dye one or two shades lighter than would be normally employed should be used; or one three shades lighter if the hair has been over-bleached; otherwise a very dark shade, or even black, will result. The hair of persons of a nervous temperament has also been found to be abnormally sensitive to henna.

Generally speaking, it is inadvisable to attempt to apply henna to hair previously coloured with some other dye. In cases of dyed hair it is better to remove the old dye with a suitable decolorant, if possible, before applying henna.

PREPARATION OF THE HENNA PASTE

For dyeing a complete head of long hair, about 200 grams of henna powder are required. If the hair is very long and thick, rather more than this may be necessary, whilst for a shingled head the quantity can be reduced to about 120 grams. Proprietary henna powders are usually put up in tins each containing sufficient for one operation, smaller tins being available for dyeing shingled heads and retouching.

When a compound henna is employed, it is very necessary for the ingredients to be *thoroughly mixed.* Proprietary hennas are sometimes packed in layers to prevent chemical reaction between the constituents and consequent deterioration of the dye as a result of storage. Before use, therefore, the *whole* contents of a tin of compound henna powder packed in this manner should be emptied out on to a sheet of paper, any lumps crushed with a horn or bone spatula (or a wooden paper knife) and the powder thoroughly mixed.

For preparing the paste, a double saucepan is required, similar to a milk or porridge saucepan, with an inner container made of china or some other non-metallic material. The latter point is essential, because the henna must not be allowed to come into contact with anything of a metallic character. Special henna saucepans are obtainable at a reasonable price from hairdressers' sundriesmen and from several firms which specialise in henna preparations.

A sufficient quantity of water is placed in the outer saucepan, brought to the boil and the supply of heat then turned off. The finely crushed and well mixed henna powder is placed in the inner container. Very hot water,* just off the boil, is then gradually added, the mixture being constantly stirred with a bone or horn spatula, or a wooden spoon, until it forms a smooth paste having a thick creamy consistency. The paste must not be made too thin, because a thin cream will not produce the desired shade.

It is advisable to prepare the paste before the hair is shampooed, in which case the mixture must be kept hot, but *must not be allowed to boil.* In any case, the paste must be left for at least five to ten minutes before the application is made, in order to allow the lawsone to become thoroughly extracted.

Not only should the paste be prepared hot, but it must be

---

* An infusion of coffee may be used in place of water, and appears to improve the dye.

kept hot right throughout the process, and applied hot to the hair. This is especially important in the case of henna-reng, the damp warmth setting up a process of fermentation without which the dye is not set free from the glucoside in which it occurs in the indigo leaves. It is usually necessary to add a little hot water before commencing the application, as the paste thickens slightly whilst standing.

METHOD OF APPLICATION

Before dyeing with henna, the hair must be shampooed; and in drying the hair afterwards care must be taken not to rub the scalp too hard, as this may render it over-sensitive and cause a smarting sensation to be experienced when the paste is applied. Whilst the hair should be fairly well dried, it is not necessary for it to be absolutely dry. Special care, however, must be taken to get it out of tangle before proceeding with the application.

Henna must be applied as hot as can conveniently be borne.

The secret of successful henna dyeing lies in the mastery of a regular system of application, this being, perhaps, even more important in the case of henna than in that of applying liquid dyes. Without a systematic method of application, the operation will not only take much longer, but there is a danger of the hair getting badly tangled, parts of it being missed, and the correct shade not being produced.


FIG. 16.


FIG. 17.

HENNA DYEING.

Fig. 16.—Four-Section Partings.
Fig. 17.—Partings for Shingled Hair (Combs in Position).

It is necessary for the hair to be divided in such a manner that each hair receives its correct amount of henna paste. When a full head is to be treated, the hair may be divided into four sections by means of two partings, one parting running from the forehead to the nape of the neck and another from ear to ear, as shown in Fig. 16. In the case of bobbed or shingled hair, it is only practicable to make a parting down the centre from the forehead towards the nape of the neck, using combs to keep the sections apart, as shown in Fig. 17.

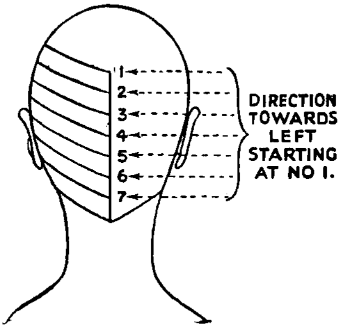


FIG. 18.

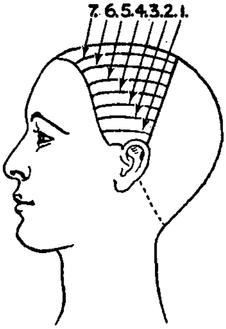


FIG. 19.

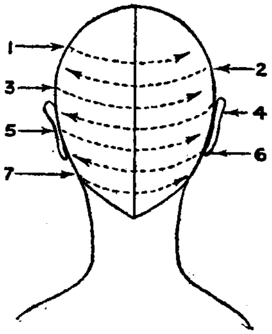


FIG. 20.

HENNA DYEING.

Fig. 18.—Back Partings ; Fig. 19.—Side Partings ;
Fig. 20.—Alternating Partings.

If the method of four-section partings shown in Fig. 16 is adopted, the operator applies the paste to small sections of hair, about ½ inch in thickness, starting in the middle of the head, where the hair is generally thicker and coarser in texture, the work proceeding from the centre towards the left, as shown in Fig. 18. The side hair on the left is then treated in the same sectional way, as shown in Fig. 19. After the left half of the head is impregnated with the paste, the right half is dealt with in a similar manner.

In actual practice, however, it has been found that, unless the operator works very rapidly, the method just described for treating the back of the head tends to result in one side of the head being dyed a slightly different shade from the other. In order to obviate this unpleasant result, we strongly advise the adoption of the alternative method for dealing with the back of the head illustrated in Fig. 20, a method which experience has shown to be very suitable for all purposes. It has been called the "criss-cross" method, but is more accurately described as the method of "alternating partings." If this method is adopted, the back parting shown in Fig. 16 is not required. The application of the paste is commenced at parting No. 1, the work proceeding *from the left ear to the right.* Parting No. 2 is then treated. This time, however, the work proceeds *from the right ear to the left.* The application is then continued in the same alternating manner to the nape of the neck.

FIG. 21.—HENNA DYEING. Treatment of Shingled Hair.

The sides are dealt with in the manner described above, using the system of partings shown in Fig. 19. The method is further illustrated for a shingled head in Fig. 21. In the case of long hair, as each front and outer section is completed, it is coiled round the head so as to build up a henna pack or paste turban.

Throughout the whole operation, the difference in the resistance of the roots, lengths and ends of the hair, pointed out in previous chapters, must be borne in mind. Before treating the lengths, therefore, the henna paste should be diluted with a little hot water. The hair at the nape of the neck is usually less grey than the rest of the hair, and it is therefore best to use the paste similarly diluted in treating this section. Generally speaking, the points, except when very grey, require a still more diluted paste, as they usually absorb the colour very easily.

Considerable divergence of opinion exists as to the best shape and style of brush for applying the paste. We recommend the use of a flat brush with fairly stiff bristles in preference to one of the paint-brush type, as a flat brush is found to be more effective for working the paste through the hair at the roots.

When the application of the paste is finished, it is necessary for the head to be completely covered in order to prevent loss of heat. At one time, towels applied in the form of a turban were thought to be ideal, but experience has shown this device to be unsatisfactory, hot towels especially being undesirable, as both the pressure of the towels and the extra heat tend to cause uneven colouring. The much better plan, as well as the simpler, is to use cotton wool (preferably the form known as " neck-wool ") as the first covering, confining the use of this to the edges of the hair, over the ears and round the neck, and then to apply a turban made of newspaper.

THE PAPER TURBAN

There is a right way and a wrong way of making a turban of paper, the wrong way being one which results in disturbing the whole of the pack. The right way is illustrated in Figs. 22–25, and, after a little practice, quite a chic head-covering can be produced.

A single page of a full-sized newspaper is folded down the long edge to a depth of about 4 inches, as shown in Fig. 22, or, if preferred, a sheet of *soft* brown paper about 24 inches by 18 inches may be used instead. The paper is placed with the fold inwards, across the forehead just above the eyes, as shown in Fig. 23. The paper, firmly held by the fingers, is then slid lightly over the head, as shown by the arrows in the figure, until the centre of the fold rests upon the hair at the nape of the neck, which hair must be completely covered. This has to be done by a deft movement, care being taken not to disturb the henna pack.

The paper is bent round the head, the ends meeting and slightly overlapping in the middle of the forehead, so as to form a cylinder, which almost covers the ears. The two edges are pinned together near the bottom, as shown in Fig. 24. The top of the cylinder is then folded in, to form a turban completely covering the head, as illustrated in Fig. 25. This is best effected by the operator first placing his right hand, palm downwards, on the front of the cylinder, and then gently pressing the paper down until it rests lightly upon the head, the back part of the cylinder then being folded inwards. The object of the turban being to prevent loss of heat, in folding the cylinder of paper, care must be taken not to leave any open spaces between the folds.

TIMING

The question of the period that should be allowed for the dye to act is one of great importance, and careful timing is a most important factor in the achievement of satisfactory results.

For dyeing with henna-rasticks, the Table below will be found a reliable and satisfactory guide, Column 1 giving the shade and Column 2 the period for which the paste should be left on, though no table of this sort can obviate judgment on the operator's part, as allowances have to be made for many factors, including differences in the texture of the hair. As pointed out already, coarse hair tends to resist the action of henna much more than fine hair. In the case of very coarse hair it is desirable to leave the paste on a little longer than indicated, or, in exceptional cases, to choose a henna of a darker shade. On the other hand, in the case of very fine hair, the period during which the paste is left on should be reduced, or henna of a lighter shade employed.

TABLE FOR TIMING HENNA-RASTICKS

Colour.	Minutes.
Blonde	5 to 10
Light brown	20
Mid-brown	30
Brown	30 to 35
Dark brown	45
Black	60

PLATE VIII.

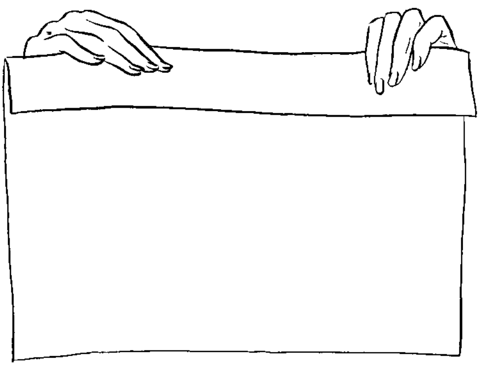


Fig. 22.—Folding the Paper.

Fig. 24.—Paper Pinned in Position.

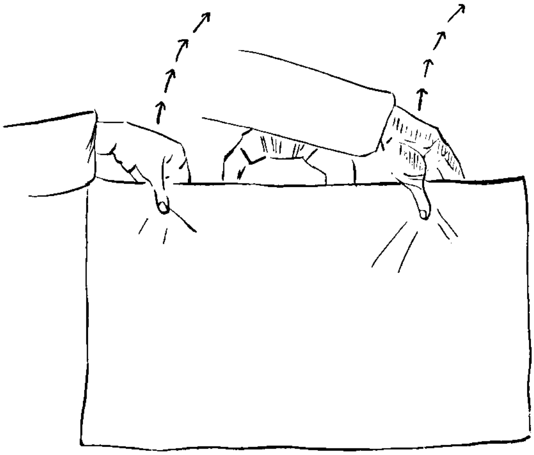


Fig. 23.—Applying Paper to Forehead.

Fig. 25.—The Finished Turban.

FIGS. 22 to 25.—HENNA DYEING—THE PAPER TURBAN.

[*To face p.* 150.

In the case of henna-reng longer periods will be found necessary.

In using the Table it should be remembered that, in tropical climates and during the hot summer days in Great Britain, henna works very quickly, and allowance must be made for this fact, the paste not being left on the hair too long in such climatic conditions as these. In cold, wintry weather, on the other hand, it is usually necessary to leave the paste on rather longer than usual.

After the paste has been left on the hair the correct period, it is removed by thoroughly rinsing the hair with plenty of water. The hair is then wet-shampooed in the ordinary way. In washing the hair after a henna dye, one must not be afraid of using too much water.

Sometimes the hair is left rather sticky after the shampoo. This is due to carbonates in the water, in which case it will be found useful and effective to mix a little vinegar or dilute acetic acid with a pint of warm water for the last rinsing.

It must be remembered when dyeing with henna-rasticks, that it takes at least twenty-four hours for the full shade to develop, darker shades taking up to forty-eight hours. Hairdressers are advised to explain this fact carefully to clients, who may otherwise be disappointed and dissatisfied to find that there is little or no change in the colour of the hair immediately after the application.

RETOUCHING

So far we have been dealing with the technique of dyeing the whole head of hair with henna. As in the case of liquid dyes, however, periodical retouching is necessary and constitutes the most difficult part of henna dyeing. In retouching with henna, the hair is divided in the manner previously described, as though it were going to be completely dyed. The paste is then applied as shown in Fig. 26, great care being taken not to let it run on to the parts already tinted. This precaution is absolutely essential. A good plan to prevent the henna paste running on to the previously dyed lengths is to brush a little oil or brilliantine on to them as advocated in the section on Retouching in the chapter dealing with Liquid Dyes.

As each strand is retouched, a piece of neck-wool is placed between this and the previous strand, as shown in Fig. 27. The wool acts as a buffer, preventing any of the paste touching parts where it is not required. The same expedient will be found useful, not only in retouching, but also in dyeing a full head where the colour desired is on the light side. Fig. 28 shows the full head retouched, with the neck-wool buffers in position as explained.

Some hairdressers advocate the use of strips of paper about an inch wide instead of neck-wool. Experience, however, shows that paper tends to slip, thus disturbing the job, and, unless specially treated, paper absorbs the paste. Oiling the paper has been urged to obviate this latter defect, a device which is most unsatisfactory as it makes the paper more slippery. Moreover, if oiled paper is used, it is very easy to soil the hands and thereby to transfer oil to the hair and prevent the dye taking.

FIG. 26.—HENNA DYEING. Retouching.

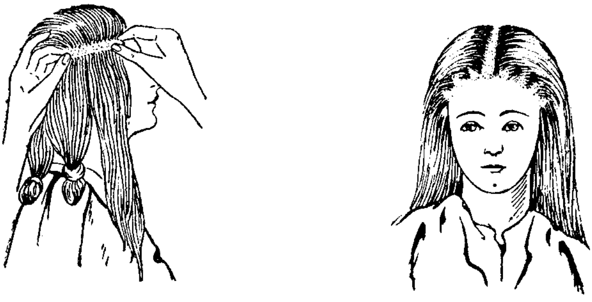


FIG. 27. FIG. 28.

HENNA DYEING—RETOUCHING.

Fig. 27.—Applying Buffers.
Fig. 28.—Buffers in Position.

It may be usefully noted that, contrary to the general rule that dyed hair must be retouched with the dye originally used, hair originally dyed with a henna-rastick may be retouched with a liquid rastick based on similar ingredients to those originally used in conjunction with the henna.

SOME COMMON FAULTS

Such highly satisfactory results from an æsthetic point of view can be obtained by the use of henna, that it is very desirable for every hairdresser to master the rather difficult technique of henna dyeing. Faulty colouring, however, is not infrequently obtained, which defect is generally due to lack of attention to small points. It may be useful, therefore, to indicate some of the commoner causes of unsatisfactory results.

The chief causes of the production of over-light shades are :

(*a*) The paste not left on long enough.

(*b*) Boiling water, instead of hot water, used for mixing the paste.

(*c*) The paste made too thin.

Over-dark shades, on the other hand, may be due to one or other of the following mistakes :—

(*a*) Paste left on too long.

(*b*) The hair over-bleached previously to dyeing.

(*c*) Over-estimation of the percentage of white or grey hair.

Patchy results are due to one or other of the following reasons :—

(*a*) Henna allowed to overlap on to previously tinted hair.

(*b*) Application made too slowly, with consequent faulty timing.

(*c*) Paste thinned down before greyest parts properly covered, or watered down too much.

(*d*) Head wrapped in hot towels or some heavy type of turban.

Very bad colours (including green) are sometimes obtained with henna-rasticks as a result of failure to mix the ingredients thoroughly.

CHAPTER IX

THE TECHNIQUE OF BLEACHING AND DYEING FOR POSTICHE

An important branch of the art of hairdressing is that known as " Boardwork "—the working in human hair separated from the head and its preparation for purposes of personal adornment. The wearing of " false hair," or " postiche " as it is preferably called, the hair only being false in the sense of not growing on the wearer's head, dates back to earliest times. For theatrical and legal purposes, " false hair " strictly so called is used, prepared tow, jute, fibre, horsehair, etc., being much employed for making the wigs worn on the stage and bench. A consideration of the bleaching and dyeing of these latter materials lies outside the scope of this book.

As fashion decrees changes in the prevailing type of coiffure, so corresponding changes are necessitated in the art of preparing postiche ; but whatever the fashion may be, there are always deficiencies of nature and ravages of time which call for concealment or camouflage.

The discovery by woman of the advantages of short hair has naturally led to a decrease in the demand for postiche ; and it is, to say the least, extremely doubtful if she will ever return to the wearing of the large, inconvenient and unhealthy postiche that she tolerated in the past.

Nevertheless, short hair for women and postiche are not incompatible. A reaction has set in against the Eton crop and other inartistic forms of excessively short cuts ; and there is every indication of the rise of a new form of postiche which, if we may be permitted to coin a term, may very well be called " petite postiche."

The hairdresser who wishes to be a master of his craft must be fully versed in the intricacies of boardwork in all its ramifications. These include the bleaching and dyeing of cut hair and combings, and the preparation of the hair for these operations, to a consideration of which this chapter is devoted.

Human hair is a commercial product, and that on the market can be divided into two main grades, European and Asiatic. The latter is usually straighter than European hair, being more exactly circular in section ; it is coarser in quality and less expensive. Good quality grey hair and white, often required for making postiche for the elderly matron, are particularly dear. The wise hairdresser, however, will have saved the shorn locks resultant from the short hair fashion, bearing in mind that it is desirable to have in stock hair of every colour ; and white hair need not be purchased, but can be made by the process of bleaching.

BLEACHING FOR POSTICHE

Not only can pure white hair be made by bleaching other varieties ; but the process is often a useful preliminary to dyeing and an essential one if the finished colour is to be lighter than that of the original. Moreover, by means of bleaching, hair of a bad colour can be made of use. Naturally the quality of the finished product depends upon that of the original hair, and, according to the purpose for which this is required, the hairdresser must decide whether good quality European hair is necessary, or whether cheap Asiatic hair will suffice.

At one time, bleaching hair for postiche was effected by treating it, in a special cabinet, with the fumes of burning sulphur. These fumes consist mainly of sulphur dioxide, a gaseous substance which bleaches by reduction, being converted into sulphuric acid in the presence of water and a material capable of yielding oxygen. This cumbersome method is now, however, entirely obsolete, and is mentioned merely as a matter of historical interest.

The best material for bleaching hair for postiche is the same as that employed for living hair, namely hydrogen peroxide of 20 vols. strength, activated by means of 0·880 ammonia, in the proportion of 1 part by volume of the ammonia to 20 to 40 parts of hydrogen peroxide according to whether it is desired to effect the work rapidly or slowly.

As in the case of living hair, before hair for postiche purposes is bleached it must be thoroughly cleansed. To effect this, the hair is hackled, tied loosely, and put for ten to fifteen minutes in a bath of hot water containing about 5 per cent. of washing soda. After rinsing it is dried, carefully disentangled, stumped and divided into sections, each section being securely tied at the stumped ends.

The hair is now ready for bleaching. The best vessels for carrying out this process are the porcelain developing dishes with a corner lip used by photographers. A sufficient quantity of the bleaching solution, prepared as above, having been poured into the dish, the hair is immersed in the liquid and thoroughly impregnated with it by means of constant turning and pressing. When the desired colour has been produced, the hair is removed, rinsed and hung up to dry.

It will be understood that as more and more hair is placed in a bleaching bath, the solution becomes gradually weakened, the whole of the hydrogen peroxide finally being converted into water, when, of course, the liquid is no longer of any use and has to be thrown away. To test whether this is the case, a little of the liquid should be poured into a solution of potassium permanganate acidulated with sulphuric acid, contained in a test tube or small bottle.

If the bleaching solution fails to destroy the colour of the permanganate, its bleaching powers are exhausted, and it is of no further use. The volumes of bleaching solutions required to decolorise equal amounts of potassium permanganate give a rough guide as to their relative strengths.

It is a remarkable fact that the reddish yellow pigment of hair is much less susceptible to the action of hydrogen peroxide than is the sepia-brown one, the different effect produced by this reagent on red hair and that of a shade belonging to the ash series providing good evidence of the existence of two chemically distinct pigments in human hair. When, therefore, it is required to produce hair of an ash-blonde shade by means of bleaching, red hair or hair of any colour showing a reddish tinge should be avoided.

For the same reason it is usually impossible to bleach hair snow white by means of hydrogen peroxide ; further treatment being necessary to neutralise the yellow tinge that still remains after prolonged bleaching with this reagent.

PREPARATION OF SNOW WHITE HAIR

Snow white hair can be obtained by bleaching with either (*a*) potassium permanganate or (*b*) hydrogen peroxide, in the latter case the thoroughly bleached hair being treated with a very weak solution of a blue dye to neutralise the yellow colour.

In method (*a*) the hair is immersed alternately in two solutions, the first containing potassium permanganate, the second either dilute sulphurous acid or hypo acidulated with sulphuric acid, using the concentrations given on p. 56.

Method (*b*), however, is the preferable one. Any sort of hair can be used, provided the original colour has not a pronounced red tinge ; and the hairdresser will find the method a most valuable one, as by its aid odds and ends of hair, including hair of a bad colour, may be made into useful material for postiche.

To commence with, the method described in the preceding section is employed, the hair being allowed to remain in the bleaching bath with occasional turning and pressing for eight hours or more. After this treatment it is immersed in hot water containing 5 per cent. of washing soda for another half an hour, being well pressed, so that any material which may have been loosened in the bleaching bath may be removed.

After rinsing, the hair is hung up to dry overnight, the treatment being repeated next day, and the following days, until the colour of the hair is a whitish yellow, like flax. Six bleaching baths at the most will be found sufficient to effect this ; in many cases a smaller number will be all that is necessary.

After bleaching, the hair is dried, hackled and prepared for the blueing by being restumped and tied up in small sections about a third of the size of those previously used.

As intimated above, the faint yellow colour that remains in such hair is neutralised by treatment with a very weak solution of a blue dye. The homely blue bag may be requisitioned for this purpose, or alternatively a weak solution of an aniline dye may be employed.

A good solution for this purpose can be prepared by using a mixture of methyl violet and malachite green. Separate stock solutions of these are prepared by dissolving 10 grams of each in a litre of distilled water, care being taken to see that each crystal is completely dissolved, because if an undissolved crystal should come into contact with the hair a streak of dark colour may be produced.

The blueing is carried out in a basin of warm water to which small quantities of the two-dye solutions are added, the amounts of each being adjusted so as to produce the shade required to neutralise the yellow tint of the hair. It will be found advantageous to add to the bath a few drops of acetic acid and a little glycerine. After the bath has been prepared, the sections of hair are immersed, first one half and then the other, the strength of the bath and the proportion of the ingredients being adjusted if necessary. The hair is then finally dried by wrapping each section in a towel, which has been placed ready to hand, and wringing it out.

It may be added that dyed hair can be bleached for postiche purposes, hydrogen peroxide plus ammonia being one of the most useful reagents for removing old dyes. However, dyed hair so often needs such drastic and prolonged treatment that it is frequently damaged in the process, and the resulting product is hardly worth the labour that has to be expended upon it.

DYEING FOR POSTICHE

It is often necessary to dye pieces of hair in order to obtain shades suitable for mixing or to match colours which have been produced on the head by artificial means. Dyeing is also necessary in cases where old switches or faded combings have to be remade, and in other cases where hair of a bad or faded colour has to be handled.

Dyeing for postiche purposes can be effected by the aid of any of the dyes used for living hair, and many of these are, in fact, employed for this purpose to-day.

With reference to the use of para and allied dyes for postiche purposes, it has been pointed out in Chapter XIII. of Part II. that dermatitis has been known to result from the wearing of postiche and furs dyed with these substances. The use of para and allied dyes for postiche purposes must, therefore, be strongly condemned, as it is obviously impossible for a person to undergo the Sabourard-Rousseau test each time before an article of this sort is worn. In addition to para, it may be added that a number of other well-known aniline dyes are employed, such as Bismarck brown, Bismarck brown R and nigrosin. The first, made from metaphenylene-diamine is a fugitive chestnut dye ; the second, made from metatoluylene-diamine is a more permanent chestnut dye ; whilst the third, a sulphonic compound of complex constitution, is a blue-black dye.

Hair which has been removed from the head can, of course, be subjected to treatment which would be impossible in the case of living hair, such as immersion in a bath of boiling liquid, and much may be said in favour of using for postiche purposes the old-fashioned vegetable dyes described in Chapter VIII. of Part II., the successful application of which necessitates this operation.

TECHNIQUE FOR VEGETABLE DYES

If the dyes last mentioned are employed, the operation of dyeing is best carried out in an enamelled pan. The vessel must not be chipped, as otherwise the dye may react with the exposed iron, and it must be carefully cleaned after each operation. The dye solution is put in the pan and the liquid brought to the boil. The hair is then immersed, and the mordant dissolved in water added. The shade obtained depends upon many factors, including not only the nature of the dye and mordant used, but also the original colour and texture of the hair, the strength of the solution and the time the hair is boiled in it. Some suggested formulæ have been given in Chapter VIII. of Part II. The operator, however, is advised not to attempt to work by rule of thumb, but rather to be guided by his own experience, using the formulæ given as the basis of experiment. The safest plan is to start with a weaker solution than that calculated to produce the desired result, and to strengthen it, if necessary, as the work proceeds. It will, of course, be understood that, unless more water is added from time to time, the solution automatically becomes stronger as the result of evaporation. When the right colour has been obtained, the hair is removed from the bath, and well rinsed with warm water. The excess dampness is pressed out with an old towel and the hair is then hung up in a warm place in order that it may dry slowly.

The process known as "saddening," that is, final treatment with a weak solution containing the mordant only, tends to render the colour more permanent. Saddening with iron and copper is useful for intensifying the tone, for which purpose the following solution may be employed :—

Ferrous sulphate	20 grams.
Copper sulphate	20 ,,
Distilled water . . . to	1 litre.

The hair is either immersed in the hot solution, or else brushed with it.

Chiefly perhaps because of the ease with which they can be made, dyes made from blue-black writing ink find favour with many hairdressers, more especially for restoring the colour of faded switches. The method of dyeing with ink, which liquid, as pointed out in Chapter VIII. of Part II., is essentially tannin and gallic acid fixed with an iron mordant, is similar to that employed in the case of logwood and other vegetable dyes, the operation being effected by immersing the hair in the boiling ink, diluted as may be required with water, the boiling being continued until the required colour is produced. The colours obtained vary from ash brown almost to black. The method is not recommended for red hair, bleached hair, or hair which is badly faded. If the colour is too dark, it may be reduced by means of a weak solution of oxalic acid.

A similar method is adopted in using the pyrogallol formula given in Chapter VIII. of Part II., the stock solution being diluted with more or less boiling water as may be required. After dyeing, the hair must be thoroughly washed with soap and warm water containing washing soda.

TREATMENT OF COMBINGS

The hairdresser is frequently asked to make up postiche from combings which have been collected over a considerable period of time, with the result that there is a discrepancy between the colour of the combings and that of the hair on the head, the latter often being slightly darker. When this is the case, the best plan, after the combings have been hackled and stumped, is to divide them into three sections, which, for the sake of convenience, we will refer to as Nos. 1, 2 and 3. Section 1 is carefully dyed the faintest shade darker than the client's living hair, of which, of course, the hairdresser will have taken a sample. This section is then carefully mixed with Section 2. If the resulting shade is too dark, hair from Section 3 is judiciously mixed with it until exactly the desired effect is produced. If, on the other hand, the shade is too light, Section 3 is dyed and mixed little by little with the rest. By means of this device an exact match can be obtained, it being much easier to get this by mixing hair of *slightly* different shades than by attempting to dye the hair directly to match.

DYEING WIGS AND TRANSFORMATIONS

Wigs and transformations have to be dyed on the wooden block in order to obviate shrinkage or any alteration in shape. Consequently dyeing cannot be effected by means of boiling, and a special technique is required.

The wig or transformation is first firmly affixed to the block by means of " block points," and the dye is then applied by means of a brush, either in cold or hot solution according to its nature. The dye chosen, however, should never be of a toxic character, owing to the practical impossibility of satisfactorily washing the wig. After the colour has developed, or before, if heat is necessary to effect this, the block with the wig attached is placed in a slow oven and allowed to dry, the process being repeated as many times as may be necessary to produce the desired shade.

PART IV

ON THE CAUSES OF GREY HAIR, WITH SOME HINTS TO THOSE WHO WISH TO AVOID PREMATURE GREYNESS

Loss of colour by the hair, whether general or restricted to certain groups of hairs, and whether resulting in grey hair or white, is known by the general term " canities," the word being derived from the Latin " canus," meaning " grey."

The subject of canities is shrouded in much mystery, many conflicting views having been expressed as to the proximate cause of the phenomenon, that is, of the means whereby the loss, or apparent loss, of the pigment is brought about. Before examining these, however, a consideration is desirable of the various conditions which, if not productive of canities, seem favourable to its occurrence.

CONDITIONS CONDUCIVE TO CANITIES

Canities occurs with about the same frequency in women as in men, sex apparently not entering as a factor into its causation. Heredity, on the other hand, appears to be a very important factor, several cases having been recorded of families in which canities has occurred in successive generations at the same age. Albinism, which is characterised by a complete lack of pigment from birth, is also hereditary. This latter is a rare phenomenon, quite distinct from ordinary canities.

Grey or white hair is a usual concomitant of old age, this form being known as " senile canities." The view has been expressed that old age is inevitably accompanied by grey hair ; but we are not prepared to accept this, and consider that canities must always be regarded as an abnormal state. Certainly canities prematura, as the greying of the hair in young people and those of middle age is called, is abnormal and due to a diseased condition.

Unfortunately this affliction is not uncommon and seems to be on the increase amongst the civilised races of mankind.

Greying of the hair may frequently be noted as an accompaniment to or a development of certain specific diseases. Thus, for example, certain fevers, especially scarlet fever and typhoid, as well as the severer forms of influenza, often leave greyness in their wake ; and cases of partial or complete canities have been observed to follow melancholia and hysteria. Moreover, canities often results from certain morbid conditions of the scalp and hair itself, which in such cases may be regarded as the direct cause of the greying. Of these conditions, seborrhea, which has already been referred to in Part I., must be regarded as one of the chief causes of canities, a view strongly endorsed by Dr. Hubbard, who says that in his experience " premature greying has most frequently been incident to the presence of seborrhea." *

Other morbid conditions of the hair and scalp with which canities is often associated are alopecia areata and pityriasis.

Alopecia areata is an obscure disease of the scalp in which the hair falls out in round patches. Its cause is unknown, but the disease does not appear to be associated with any bacterium, and must be sharply distinguished from ringworm, a highly contagious disease, whose symptoms somewhat resemble it. Alopecia areata may persist for months or even years, and if new hair is formed on the previously bald patches, this is frequently white. The colour may be recovered after a time ; but in some cases the whiteness is persistent ; more especially if the patient is over forty.

Pityriasis is a disease of the scalp in which there is a continual exfoliation of the horny layer of the epidermis, resulting in the formation of dandruff. Two forms may be distinguished, namely, pityriasis simplex, in which the scalp is covered with dry or powdery scales, and pityriasis steatoides, in which the scales are of a greasy character. The latter disease would appear to be pityriasis plus seborrhea. The

---

* S. Dana Hubbard : *A Treatise on Diseases of the Hair and Scalp* London, 1928), p. 206.

formation of greasy dandruff has been referred to as a special form of seborrhea, distinguished as "seborrhea sicca," the scales being assumed to consist of dried sebum. They are not, however, completely soluble in ether, which would be the case were this assumption true; and modern authorities regard dandruff as always indicating the presence of pityriasis. In either case, dandruff is a symptom of a diseased condition of the scalp, which may eventuate, unless properly attended to, in greyness or even loss of hair.

Leuco-derma, popularly called "white skin," may also be mentioned in this connection. This rare disease usually occurs in patches, the hair on the affected parts often being blanched.

GRADUAL AND INSTANTANEOUS GREYING

The greying of the hair is usually a very slow process. All, or practically all, the hairs may be involved, a slow change taking place in their colour, which gradually becomes grey or white. On the other hand, the greying may be scattered in its effects, a condition of the hair popularly described as "iron grey," often lasting for years, after which whitening may take place more or less rapidly. Or again, the hair of certain regions of the scalp, more especially that of the temples, may be affected, whilst the rest of the hair shows little or no alteration from its virginal colour.

If the hairs of the head which is going grey are examined, single hairs can sometimes be found showing a range of colours from grey to the original shade, the greyness in such instances usually appearing at the "roots," where the hair is newly grown, though in exceptional cases, it would seem to be the "points" which are affected first.

Although slow in its operation, often so slow as to be imperceptible, once greyness has set in there is usually a development towards complete loss of colour.

It is popularly believed that under the stress of an intense emotion of an unpleasant character, such as fear or grief, hair will become grey with a rapidity which can only be characterised as instantaneous. In *The Times* for March 26th, 1828, for example, an account is quoted from the *Mac-*

clesfield Courier of an antiquarian who was accidentally shut in the Royal vault at Windsor. He was rescued next day, but the terror which he had experienced caused his hair to turn from black to grey, and soon afterwards it became white.

Dr. Robinson * quotes an even more interesting case, reported by two doctors (Landois and Lohmer) in 1866, of a patient suffering from delirium tremens, whose hair turned grey in one night, whilst he was in hospital. The whitened hairs were examined microscopically. Pigment was present plus a great number of air bubbles. Unfortunately the hair does not appear to have been examined microscopically before the change took place.†

A more frequently quoted instance of the phenomenon of sudden canities is that of Marie Antoinette, whose hair is said to have turned white as a result of her imprisonment. In this case, however, it may reasonably be suggested that the change was due to the fact that she was deprived of her customary hair-dye; and the possibility of the colour of hair changing instantaneously is now generally discredited by the medical profession, both on account of the paucity of well-accredited instances and of the difficulty of conceiving any mechanism whereby the change might be so produced.

On the other hand, that the emotions may operate as a factor in the gradual production of canities may well be credited. Hardship and privation may exercise a like effect. For example, Major-General H. D. Greely, who was in charge of the ill-fated international Polar Expedition of 1881, has stated that when he was rescued at Cape Sabin in 1884, his hair had become entirely white, this effect being probably due to the continuous condition of semi-starvation from which he had suffered for over nine months. He says that his hair

---

* T. Robinson, M.D.: *Baldness and Greyness: their Etiology, Pathology and Treatment* (third edition, London, 1891), p. 42.

† A similar phenomenon is stated to have been observed in the case of animals. For example, in a lecture given by Dr. O'Donell to the Bournemouth Hairdressers' Assistants Society in 1921 (*Hairdressers' Weekly Journal*, 1921, Vol. 40, p. 295), an instance is related of a Spanish cock which was nearly killed by some pigs. Next morning the feathers of the bird's head had become completely white, about half those of the back and neck also having been affected.

darkened very considerably during the next year, though the original chatain colouring was never recovered.

RINGED HAIR AND OTHER ABNORMALITIES

A remarkable peculiarity sometimes shown by individual hairs is that of being coloured in bands which alternate with narrow rings of white. This rare phenomenon, cases of which have been reported by Sir Erasmus Wilson, Dr. Landois and others is known as "ringed hair" or "leucotrichia annularis." It would appear to be due to a periodic arrestment of the pigment-producing process, the place of the pigment in the white rings being taken by air bubbles. A rather fantastic theory put forward to account for the peculiarity is that the coloured bands are the day growth of the hair, whilst the white rings are produced at night. These rings, it may be added, are often very narrow, being sometimes no more than one-hundredth of an inch in width. Microscopic examination shows ringed hair to be quite normal in all respects other than the peculiarity of its pigmentation.

Apart from greying, hair sometimes assumes quite abnormal colours. Effects of this character may result from the use of certain drugs; for example, resorcinol, a frequent ingredient in hair tonics, tends to colour the hair a sandy brown, whilst chrysarobin, sometimes used in the treatment of psoriasis, may, under the action of the alkali in the soap used for washing the hair, colour it a reddish purple. These are really cases of unintentional dyeing. The hair of workers in certain industries also runs the risk of becoming dyed abnormal shades as a result of the action of chemicals with which they come into constant contact; for example, the hair of those engaged in copper-smelting sometimes becomes dyed a bluish green, whilst the hair of those habitually handling crude aniline may become coloured a red brown.

The action of pilocarpin on the colour of the hair, a matter of particular importance, will be dealt with later.

THE ETIOLOGY OF CANITIES

We may now turn our attention to a consideration of the various theories which have been put forward to explain the manner in which coloured hair becomes grey or white, and to which brief reference has been made in Chapter IV. of Part II.

As explained in Part I, the macrocosmic colour of the hair is due, not only to the presence of pigments, but also to that of air bubbles in the cortical layer of the hair-shaft. On the face of it, therefore, it would seem that grey or white hair must be the result of decrease in the amount of the pigments or an increase in the number of air bubbles.

An alternative theory, however, has been put forward by Pfaff.* According to him, a microscopical examination of white hair revealed the presence of abundant dark pigment granules in the medulla, and he was therefore led to consider ordinary greyness to be due, not to loss of pigment, but to the thickening and consequent opacity of the horny layer, which concealed the colouring matter of the hair from sight.

The view that the white hair of canities is not entirely destitute of pigment is borne out by the fact that this hair is quite different from the white hair of albinism. Moreover, the white hair of a person who was originally a brunette differs from that of one who was at first a blonde. As a matter of fact, dark-haired persons rarely go completely white, the hair more frequently becoming an iron-grey. These facts lend some support to Pfaff's contention. His theory, however, certainly does not provide a complete explanation of the phenomenon of greyness, and there can be no doubt that, in many cases at any rate, there is a decrease in the amount of pigment.

How is this decrease in the amount of pigment brought about? In contradistinction to Pfaff, Pincus † stated that in white hair he " always found almost total absence of pigment." He further gave as his opinion that it is certain " where microscopic examination shows no colouring matter in hair just removed from the head, there never can have been any," ‡ his theory being that there is no actual *loss* of pigment, but gradual failure on the part of the papillæ to produce it, with the result that coloured hair is progressively replaced by white or grey.

---

* E. R. Pfaff: *Das menschliche Haar* (Leipzig, 1866).

† J. Pincus: *The Hair: Its Treatment in Health, Weakness and Disease* (London, 1882), p. 52.

‡ *Op. cit.*, p. 51.

On the other hand, according to Ehrmann,* there is no failure on the part of the papillæ to produce pigment, but greying results owing to the absence of the specific cells whose function is the transmission of the pigment to the hair.

A very original theory to account for greying, in which actual *loss* of pigment is postulated, was propounded by Metchnikoff in 1901.† According to this theory " atrophy of the pigment is due to the intervention of phagocytes of the hair," cells analogous to the phagocytes of the blood which absorb or devour invading organisms.

" These cells " (the phagocytes of the hair), writes Metchnikoff, " have a single nucleus and their very different aspect one from another is due to numerous amœboid prolongations of their protoplasm. They are derived from the medullary part of the hair and make their way out into its cortical layer, where they absorb the pigment granules, which they then remove from the hair."

He states that in hair, " one part of which is already white and the other still pigmented, we find a great many of these phagocytes. They are supplied with greatly developed prolongations and become insinuated between the keratic cells of the peripheral layer.

" In absolutely white hair the phagocytes filled with pigment become more and more scarce, and most frequently disappear."

Greying or whitening of the hair, therefore, results in consequence of the phagocytes swallowing up the pigment and transferring it elsewhere.

Metchnikoff suggests that this theory is capable of accounting for certain hitherto unexplained phenomena, including that of hair turning white in a night, this being accounted for by the increased activity of the phagocytes.

Metchnikoff's theory has received considerable attention and aroused much controversy. In support of it may be advanced the fact that the skin of elderly people often appears to contain more pigment than that of younger ones. Is this due to the phagocytes having removed the pigment from the

---

* Salomon Ehrmann : *Ueber das Ergrauen der Haare und Verwandte Prozesse* (1884).

† *Proceedings of the Royal Society*, (1902), Vol. 69, p. 156.

hair and deposited it in the skin? If so, sudden whitening of the hair ought to be accompanied by sudden darkening of portions of the skin. The theory also accounts for the fact that whilst the hair on living persons so often goes grey, the colour of cut hair and that on corpses seems to be permanent.

However, the very existence of Metchnikoff's phagocytes of the hair may be doubted; and certainly the theory—which is not altogether free from fantasticality—cannot be regarded as having been demonstrated.

In addition to decrease in the amount of pigment, that increase in the number of air bubbles is an important factor in the production of white or grey hair is recognised by all or nearly all authorities, and tribute must be paid to Koellicker, who first demonstrated the presence of these bubbles in the hair-shaft.

It has been observed that white hairs are frequently thicker than coloured ones growing on the same head, and, in some cases, the whitening appears to be accompanied by a perceptible bulging. These phenomena may be due to the increase in the number of the air bubbles. It should also be noted that Dr. Leftwich found grey hairs to possess a greater tensile strength than those of normal colour, a conclusion which may seem to lend some support to Pfaff's hypothesis.

In reviewing the various theories of the etiology of canities, it would appear that three factors may be operative in the production of white or grey hair, namely: (a) decrease in the amount of pigment; (b) increase in the air bubbles; and (c) thickening of the cuticle, and it seems quite possible that in many cases two and perhaps all three of these factors are at work. There has perhaps been a tendency on the part of many investigators to assume that a factor found operative in certain cases is the one and only cause. Moreover, failure to recognise the existence of at least two chemically distinct pigments in the hair has militated against a solution of the problem, which we suggest will not and cannot be completely solved until the exact chemical constitution of these pigments is known.

It may be added that even if one of the previously mentioned theories is accepted, the fundamental cause of canities seems to remain as elusive as ever; and much further investigation is required before a satisfactory answer can be given to the question, Why does the hair go grey?

THE CURE OF CANITIES

Whilst the fundamental cause of canities has so far defied elucidation, and its incidence remains as ever a great mystery, there remains the question, Can canities be cured and hair which has gone grey or white be restored to colour?

It is said that an eminent American dermatologist, when asked by one of his lady patients for advice concerning her hair which had become white, told her "to admire it." This is a counsel of despair, and an acknowledgment on the part of the medical science that canities is a disease for which it has so far failed to find a cure.

No doubt if a definite cause for canities could be established a big step would be made towards the discovery of a remedy for what is to most people a very unwelcome event, and such a discovery would be a scientific achievement of great value to mankind.

At the moment only empirical methods are possible, and no form of treatment has been devised which can be regarded either as satisfactory or sure. But it may be said that in so far as greyness is associated with senility, everything which serves to keep the body in a youthful state of exuberant health tends to prevent its occurrence.

When the first grey hair appears (that unforgettable moment!) the general condition of the body should receive immediate attention; this being specially important in cases where the history of the family shows an inherited tendency to premature greyness. For whilst it is no doubt a fact that persons otherwise perfectly healthy develop canities, ill-health is certainly conducive to it. When premature greying follows on nervous strain, general tonics and hygienic measures may serve towards retarding it. It may be added that mineral aperients should be entirely avoided, or employed only sparingly, as greying has been known to result from over-use of these drugs.

It has been supposed that canities may be associated with failure on the part of one or the other of the endocrine glands, and cases are reported where internal administration of extracts of these glands is said to have been followed by restoration of the colour to the hair, though the efficacy of the treatment still awaits demonstration.

So far as drugs are concerned, the alkaloid pilocarpin, which is present in extract of jaborandi, together with small amounts of other alkaloids, seems to have a decided effect upon the colour of the hair. Jaborandi was at one time much employed in hair tonics, and is one of the few drugs which apparently possess the power of stimulating the growth of the hair. Nowadays, its use is much restricted in this country, as the substance is a scheduled poison. Dr. Leftwich has given a prescription for a lotion containing jaborandi to arrest greyness, which we reproduce below :—

Chloroform	3 parts.
Tincture of jaborandi . . .	4 ,,
Castor oil	8 ,,
Bay-rum	24 ,,

This lotion should not, however, be used without medical advice, as pilocarpin is a dangerous poison. Pilocarpin appears to be rather uncertain in its action, Dr. Levin,* for example, stating that it sometimes exercises exactly the reverse effect and turns the hair grey !

With reference to the many so-called " hair restorers " on the market, as we have pointed out in Chapter IV. of Part II., these are nearly always progressive dyes based on lead.

Hair restorers based on iron are, perhaps, of some use, and a lotion prepared in accordance with the formula given on p. 30, can be employed with safety. If preferred, a solution containing 2 per cent. of pure ferrous sulphate crystals dissolved in red wine (claret), perfumed with oil of rosemary, may be used instead, the lotion being applied to the hair after shampooing. Perhaps these preparations should also be classed as " dyes," rather than as " restorers " ; but in any

---

* *Your Hair and Your Health* (1926), p. 68.

case, their constituents have a much closer affinity with the actual pigment of the hair than those of any other dyes.

THE PREVENTION OF CANITIES

That prevention is better than cure is an old adage which is undoubtedly true. But failing an exact knowledge of the cause of canities, it is impossible to lay down any regimen which can be absolutely relied on to prevent its occurrence.

On the other hand, all the measures suggested in the preceding paragraph—general hygienic measures, avoidance of mineral purgatives, the occasional application of an iron-containing lotion to the hair—are helpful towards the prevention of premature greyness. Moreover, there is the matter of attention to the hair itself.

It is probably true to say that the hair is more neglected than any other part of the body. And whilst the colour of hair may survive in spite of everything, the dirty, unkempt head—a breeding ground for bacteria—stands the best chance, other things being equal, of going grey. In such heads, seborrhea and pityriasis, as well as more serious diseases, are most likely to develop, bringing canities in their wake.

Frequent shampooing has been put forward as one of the causes of premature greyness. It may be, if the shampooing is improperly carried out and the hair wrongly and inadequately dried. Shampooing, however, correctly carried out with water and good liquid soap containing no free alkali, or a good spirit lotion free from deleterious ingredients, is perfectly harmless, and hair ought to be frequently shampooed as a matter of personal cleanliness and to guard against premature greyness.

The use of a good brilliantine, made with castor oil and alcohol, or with olive oil, and perfumed with an essential oil, is to be recommended both as a preventative of greyness and for toning down the grey colour if already present. The oil, as we have pointed out in Part III., strengthens the hair, and the perfume disinfects the scalp against bacterial invasion.

Singeing the hair after it is cut also may be recommended, not for the absurd " reason " sometimes given that " it prevents the hair bleeding "—for hairs not being hollow and containing no blood cannot bleed—but because it effectively removes the frayed ends of split hairs in which micro-fungi may otherwise thrive.

To sum up, we suggest the following ten rules for those who wish to preserve a healthy head of hair :—

(1) Brush and comb the hair regularly, but never use bone or metal combs or brushes.

(2) Use a good brilliantine, and, better still, have an occasional oil shampoo.

(3) Have the hair shampooed once a week.

(4) If the hair is over-greasy, use a good spirit lotion.

(5) Have the hair singed each time after cutting.

(6) If hair is dark, apply an iron lotion occasionally to preserve the colour.

(7) Choose your hairdresser with care, and if he hasn't read this book, give him a copy.

(8) Avoid constipation and consequent auto-intoxication, but don't try to remedy it by means of mineral aperients.

(9) Don't worry—not even about grey hair.

(10) Don't believe all that is stated in the advertising columns of the newspapers and periodicals.

If, however, in spite of every care, grey hairs come, there remains one certain method of hiding them. *They can be dyed.* Much research is still necessary to carry hair-dyeing to that degree of perfection of which we believe it to be capable. But even at this present state of development, by methods with which the reader of this book will now be acquainted, those who choose may quite easily become either Blonde or Brunette.

BIBLIOGRAPHY

[THERE are relatively few books devoted exclusively, or even mainly, to the subject of Hair-Dyeing. Works on beauty-culture and those on the hygiene of the hair often contain sections dealing with hair-dyeing or cognate subjects of interest to those concerned with the art. Moreover, most practical treatises on perfumery contain recipes for hair-dyes, for no better reason, presumably, than that these are often prepared with rose-water, or are otherwise perfumed. A representative selection of such books will be found in the list below, a few French and German works, which do not appear to have been translated into English, being also included. Works published prior to the present century are of historical interest only, and with one or two exceptions have been omitted. A few notes have been added for the guidance of prospective readers.]

ASKINSON, GEORGE WILLIAM, Dr. Chem. *Perfumes and Cosmetics : Their Preparation and Manufacture.* Fifth edition, New York, 1924.

(Contains recipes for hair-dyes.)

BRITISH MEDICAL ASSOCIATION. *More Secret Remedies : What they Cost and What they Contain. Based on Analyses made for the British Medical Association.* London, 1912.

(Contains analyses of a number of proprietary hair-dyes, etc.)

CERBELAUD, RENÉ. *Formulaire des principales spécialités de parfumerie et de pharmacie.* Paris, 1920.

(Contains many recipes for hair-dyes—an invaluable book.)

DURVELLE, J.-P. *The Preparation of Perfumes and Cosmetics.* Translated by E. J. PARRY, B.Sc., F.I.C., F.C.S. London, 1923.

(Contains interesting information relating to hair-dyes, together with recipes.)

GARDNER, D. HISCOX, M.E. (Editor). *Henley's Twentieth Century Formulas, Recipes and Processes.* New York, 1927.

(Contains recipes for hair-dyes.)

GASTOU, Dr. PAUL. *Les Maladies du cuir chevelu.* Paris, 1917.

GASTOU, Dr. PAUL. *Formulaire cosmétique et esthétique.* 2e édition, Paris, 1923.

(Contains recipes for hair-dyes.)

HUBBARD, S. DANA, M.D. *A Treatise on Diseases of the Hair and Scalp*. London, 1928.
(Contains a few recipes for hair-dyes based on Joseph.)

JOSEPH, Dr. MAX. *A Short Handbook of Cosmetics*. Second English edition, London, 1914.
(Contains recipes for hair-dyes in " doctors' Latin.")

JOUHAR, SARTAJ D. *Beauty Secrets and Recipes*. London, 1927.
(Contains recipes for hair-dyes.)

KOLLER, Dr. TH. *Cosmetics : A Handbook of the Manufacture, Employment and Testing of all Cosmetic Materials and Cosmetic Specialities*. Third English edition, London, 1920.
(Contains recipes for hair-dyes.)

LAZENNEC, I. *Manuel de Parfumerie*. 2e édition, Paris, 1928.
(Contains a chapter about hair-dyes, based on Cerbelaud.)

LECOQ, H. *A.B.C. des Teintures pour cheveux*. Paris, 1913.
(A very complete and valuable work.)

LEFTWICH, R. W., M.D. *The Preservation of the Hair*. Third edition, London, 1910.
(A valuable little book, containing the results of the author's important researches on the effect of various toilet preparations, etc., on the hair.)

LEVIN, OSCAR L., M.D. *Your Hair and Your Health*. London, 1926.
(A valuable work on the hygiene of the hair.)

LUCAS, E. W., F.I.C., F.C.S. *The Book of Receipts* (*Beasley*). Eleventh edition. London, 1907.
(Contains recipes for hair-dyes.)

MACEWAN, PETER, Ph.Ch., F.C.S. *Pharmaceutical Formulas*. Ninth edition, London, 1919.
(Contains recipes for hair-dyes.)

MONSÉGUR, P. A. *Hair Dyes and their Application*. London, 1915.
(Written in defence of " para." Contains some interesting information but no recipes.)

" POLY-CAPILCHROMIST." *Blue Book Recipes on Scientific Hair-Colouring*. London, 1909.
(One of the few works specially dealing with the subject, but not particularly " scientific.")

POUCHER, WILLIAM A., Ph.C. *Perfumes, Cosmetics and Soaps, with especial reference to Synthetics*. Second edition, London, 1925–26.
(Volume II. of this valuable work contains recipes for kohl, also henna, chamomile and other shampoos, etc.)

RIMMEL, EUGENE. *The Book of Perfumes*. London, 1867.
(This delightfully written book contains a number of interesting references to the history of hair-dyeing.)

SAALFELD, Dr. EDMUND. *Lectures on Cosmetic Treatment. A Manual for Practitioners.* Translated by J. F. HALLS DALLY, M.D., etc. London, 1912.

(Contains a few pages on hair-dyeing.)

SCHLÜTER, H. *Die Prinzipien des Haar-Färbens und -Bleichens.* Berlin, 1910.

SCHUELLER, E. *De l'innocuité des teintures pour cheveux.* Paris, N.D.

(Contains evidence for regarding dyes based on copper, lead, silver and pyrogallol as harmless, and of the dangerous character of para dyes.)

SCHUELLER, E. *Les Teintures pour Cheveux.* Paris, 1908.

(An interesting and informative account.)

SPALE, A. *Manuel du Coiffuer.* Paris, 1924.

STITSON, J. R., M.Sc. *The Human Hair : its Care and Preservation.* New York, 1900.

(Devotes considerable space to bleaching and dyeing.)

STRAUSS, RITA. *The Beauty Book.* London, 1924.

(Has a chapter on henna and chamomile shampoos.)

SUTTON, A. M. *Boardwork ; or the Art of Wigmaking*, etc. Second edition, London, 1903.

(The dyeing and bleaching of postiche is dealt with.)

TRAVELLER, A. *Pour le Parfumeur. Comment préparer extraits et eaux parfumées, laits et lotions de toilette, poudres, fards, pommades, cold-creams, bandolines, épilatoires, teinture capillaires*, etc. Paris, 1926.

(Contains a short section on hair-dyes.)

TRUTTWIN, Dr.-ING. HANS (Editor). *Handbuch der Kosmetischen Chemie.* Leipzig, 1920.

(Contains a good account of hair-dyes, the chemical section being by Dr. M. Bachstez, and the medical section by Dr. Edmund Saalfeld.)

VOMÁČKA, Ph. Mr. ADOLF. *Des Frisiersalons Nebenerwerb : Haarpflegemittel.* Wein und Leipzig, 1904.

WINTER, Dr. FRED. *Handbuch der Gesamten Parfumerie und Kosmetik.* Wein, 1927.

(Contains a long section dealing with the composition of hair-dyes with many recipes, being particularly detailed in its treatment of those having a metallic base.)

WOODBURY, WILLIAM A. *Beauty Culture.* London, 1912.

(Contains a chapter on " Coloring the Hair," with recipes and practical details.)

APPENDIX

SINCE this book was first published in 1929, very little work on the chemistry of hair-dyes and the technique of hair-dyeing has been done the results of which have been made public. The time does not, therefore, seem to have arrived when a complete revision of the book is necessary or desirable. In this Appendix, however, the authors have embodied some new information of interest, based largely on their own researches.

CHAMOMILE AND HENNA SHAMPOO PREPARATIONS *

Preparations containing chamomile or henna for shampooing are increasing in popularity. This is due to the facts (1) that their use, in popular opinion, is free from any opprobium that might attach to dyeing the hair, and (2) that their dyeing effects, providing the preparations are properly compounded, are just those slight ones needed to keep the colour of the hair in good condition.

For home use, shampoo powders are in big demand. These consist of mixtures of either powdered chamomile or henna, with powdered soap and alkalies. In the case of chamomile, the authors have found that German chamomile (*Matricaria Chamomilla*) is just as effective as, if not indeed better than, the more expensive Roman chamomile (*Anthemis nobilis*). The use of coconut-oil soap in powder form increases the foaming powers of the product ; but the proportion of this soap should not be too high, as, otherwise, it may give rise to irritation. The use of alkalies, in spite of their drying action on skin and hair, is imperative to prevent precipitation of the calcium salts when, as is usually the case, the powders are employed in conjunction with hard water. Sodium sesquicarbonate and borax are the best to employ, as their action is relatively mild. It is, however, possible to replace the soap, partially or entirely, by sulphonated lorol. This is the trade name for the mixture of the sodium salts of the acid sulphates of the alcohols (chiefly dodecyl alcohol) obtained by the hydrogenation of coconut oil or of its free fatty acids. The product is a white powder, readily soluble in warm water. The solutions froth like those of soap, and have a powerful detergent action. When sulphonated lorol is employed, the amount of alkali may be reduced ; and, if this substance entirely takes the place of the

---

* See Redgrove : " Further Information concerning Chamomile Shampoos," *Hairdressers' Weekly Journal* (1932), Vol. 51, p. 1751 and " Soapless Shampoo Preparations," *Chemist and Druggist* (1933), Vol. 119, p. 290.

soap, no alkali need be added. No precipitation occurs with hard water, as the calcium salts are soluble. Consequently very little rinsing is required, and the hair is left in a soft and very pleasing condition. Shampoo powders containing sulphonated lorol are more powerful in their cleansing action than soap powders, and hence smaller quantities should be employed.

Below are given some representative formulæ for high-class products. They should be scented with suitable perfume compounds, up to about 1 per cent. being employed. In the case of chamomile shampoo powders, particular care is needed in selecting perfume, as all other odours do not blend nicely with the odour of chamomile itself. Odours of the ambre type, however, are good for the purpose.

CHAMOMILE AND HENNA SHAMPOO POWDERS

Constituents, all in Powder Form.	A per cent.	B per cent.	C per cent.	D per cent.
German chamomile	5	20	—	—
Henna	—	—	7	7
Castile soap	30	—	38	33
Coconut-oil soap	10	—	—	7
Sodium sesquicarbonate	45	—	45	33
Borax	10	—	10	—
Sulphonated lorol	—	80	—	20

For use in hairdressing saloons, liquid preparations are preferred. These usually consist of soap solutions, containing a little alkali, and an extract of the colouring matter of chamomile or henna. In the case of chamomile, the Infusum Anthemidis Concentratum of the *British Pharmaceutical Codex*, 1923, may be employed for making shampoo preparations of this type. This is an extract of the florets in dilute alcohol, made by the percolation process, in accordance with the following formula :

INFUSUM ANTHEMIDIS CONCENTRATUM, B.P.C.

Chamomile flowers, in powder	40·00
Oil of chamomile	0·20
Alcohol (20 per cent.) . . . to	100·00

Sulphonated lorol is unsuitable for making clear liquid shampoo preparations owing to its low solubility in cold water ; but products known as " sulphonated lorol liquid TA " and " sulphonated lorol liquid NH," which are allied to it chemically, but are water-soluble, viscous liquids of a yellowish colour, may be usefully employed, the necessity for adding an alkali to the product being thereby obviated.

Some representative formulæ for high-class products are given below. About 0·5 per cent. of a suitable perfume compound should be added. This must be water-soluble in the cases of B and C.

CHAMOMILE LIQUID SHAMPOOS

	A	B	C
Soft soap, green	20	—	—
Alcohol	20	—	—
Sulphonated lorol liquid TA . . .	—	30	—
Sulphonated lorol liquid NH . . .	—	—	16
Infusum anthemidis conc. B.P.C. . .	5	10	4
Potassium hydroxide, 10 per cent. solution .	3	—	—
Distilled water . . . . . to	100	100	100

Preparation A must be decanted, after it has stood for some time, from the sediment which forms. Preparation B is much stronger than C.

CHAMOMILE AS A HAIR-DYE *

Experiments conducted by the authors have shown that chamomile oil has no dyeing action on the hair, whereas the infusion mentioned above, which contains non-volatile constituents in addition to the essential oil, does have a definite brightening effect. There can be no doubt, therefore, that the effectiveness of chamomile as a hair-dye is due to the non-volatile apigenin and not to any constituent of the essential oil.

---

* See Redgrove : " The Story of Chamomile and its Utility in the Hairdressing Art," *Hairdressers' Weekly Journal* (1931), Vol. 50, pp. 2184 and 2347, and Redgrove and Foan : " Chamomile as a Hair Dye," *Hairdressers' Weekly Journal* (1932), Vol. 51, pp. 1365 and 1562.

In dyeing hair with henna by the pack method, powdered chamomile may be added, with a view to modifying the colour obtained. The following table gives indications of the results that may be expected with different combinations of henna and chamomile on hair of various tints ; though a previous test is always necessary, as there are several factors, including the texture of the hair, which may affect the final result :

TINTS GIVEN BY COMPOUND HENNA-CHAMOMILE DYES

Original Colour of the Hair.	Henna, 75 per cent. Chamomile, 25 per cent.	Henna, 50 per cent. Chamomile, 50 per cent.	Henna, 25 per cent. Chamomile, 75 per cent.
Faded blonde	Golden red	Reddish gold	Golden
Light brown	Auburn red	Auburn	Light auburn
Brown	Dark auburn	Reddish chestnut	Chestnut

The authors have also found it possible to dye the hair, by the pack method, using nothing but powdered chamomile. The material does not, however, form a pack of good consistency, unless a suitable diluent is added. For this purpose, kaolin has been found satisfactory, and Fuller's earth to be even better. Two parts by weight of powdered chamomile with either 1 part or 2 parts by weight of kaolin or 1 part by weight of Fuller's earth all yield satisfactory packs. Roman chamomile of fine quality must be used. German chamomile is unsatisfactory, not because of any lack of tinctorial powers, but because it does not form satisfactory packs.

The methods of preparing and using chamomile packs, after the powdered chamomile has been thoroughly mixed with the diluent, follow the same general lines as those obtaining in the case of henna dyeing by the pack method, the following points being of particular importance.

The paste should be made with hot but not boiling water, and should be of the consistency of thin cream, thinner than is advisable with henna. About 4 ozs. of powder are needed for a shingled head.

The hair should be shampooed before applying the pack, and again after dyeing. After the first shampoo, the hair should be partially dried and the paste applied by means of a partly-worn shaving-brush. Strict attention to correct division of the hair, as in the case of henna dyeing, is essential.

To effect a nice, substantial brightening, the paste should be allowed to remain in contact with the hair for about fifteen minutes. Thirty minutes' contact produces a deeper tone and a more permanent effect. The colour becomes warmer if the paste is left on for three-quarters of an hour, while contact for an hour produces a warm blonde tint with a fine brightening effect.

The final shampooing and rinsing must be very thorough, in order to remove all particles of chamomile and diluent, which tend to cling to the hair.

MIXED METALLIC DYES CONTAINING COBALT

The use of cobalt compounds, in conjunction with those of nickel and silver, as hair-dyes, offers an interesting field for further experiment. The chemistry of these dyes is very complex and cannot be described as having been completely explored. The method of preparing stock solutions outlined on p. 53 is not completely satisfactory, as dyes prepared from these in the manner described are apt to be very alkaline, and alkaline solutions of cobalt, unless very weak, tend to deposit crystals and thus to decrease in strength. The following procedure is suggested as an improvement :—

Stock solutions are prepared containing, respectively, 200 grams of cobalt nitrate, 200 grams of silver nitrate, and 200 grams of nickel nitrate per litre, distilled water being used for making them. In addition, 100 grams of ammonium nitrate per litre are dissolved in each solution.

To obtain any weight of cobalt nitrate, silver nitrate, or nickel nitrate, all that is necessary is to measure out five times the corresponding volume of solution : thus, if 10 grams are required, 50 c.c. of the solution are measured out.

The correct amounts of the three solutions having been measured out, the dye solution is prepared as follows : The solutions containing silver and nickel are mixed together, and are rendered ammoniacal by the addition of weak ammonia solution. Enough is added to change the colour of the solution from green to deep blue, a relatively small amount being required.

The solution containing cobalt is diluted with about its own volume of distilled water. The liquid is then rendered ammoniacal by the addition of strong ammonia. Enough must be added to produce, on *vigorous* shaking, a practically clear, deep golden-brown liquid. This liquid is then boiled, the product being a clear, deep claret red solution in which the cobalt is present in the form of a complex cobaltammine compound. This deep red solution is rapidly cooled, and mixed with the ammoniacal solution containing silver and nickel. Finally, the dye solution is made up to the correct volume by the addition of more distilled water.

Dye solutions containing high proportions of cobalt do not keep well, as they tend to deposit crystals on standing.

It is desirable to emphasise the fact that mixed metallic dyes containing cobalt produce different shades according to the type of hair treated and the exact method of procedure adopted.

Another method of preparing mixed metallic dyes containing cobalt is described in Dr. Fred Winter's *Haarfarben und Haarfaerbung* (Wien, 1930), pp. 51–53, and in the same author's larger work mentioned in the bibliography.

MAKING PARA HAIR-DYES SAFE

Cases of dermatitis resulting from the use of hair-dyes of the " para " type continue to occur, and the wearing of furs which have been dyed with similar products is often the occasion of similar disasters. *para*-Phenylene-diamine itself is the chief offender, and its action in connection with the dyeing of furs has been the subject of an elaborate research by Dr. H. E. Cox, M.Sc., Ph.D., F.I.C., published, in four parts, under the general title of " The Chemical Examination of Furs in relation to Dermatitis " in the *Analyst* for December, 1929, December, 1933, and January, 1924. Many of Dr. Cox's important conclusions are also applicable to the dyeing of living hair. The chief may be summarised as follows : When fur is dyed with *para*-phenylene-diamine in the presence of hydrogen peroxide, although some Bandrowsky's base is formed, part of which is deposited on the fur while part remains in the dye bath, this substance is really an intermediate product. The principal pigment formed is an azine combined with the fur proteins. In the case of *para*-amino-phenol, an oxazine is formed in a similar manner. These pigments, as well as Bandrowsky's base itself, are harmless, and the base on the fibre is not liable to be decomposed by sweat or moisture. The real cause of dermatitis is unchanged para, remaining on the fur as the result of defective washing. Para itself is the irritant substance, and not quinone-di-imine which is at once decomposed by water. Para penetrates dead skin readily, but does not pass through or into living skin under normal conditions ; and the irritation is determined by abnormal penetration of the diamine through the skin, followed by its local reaction with certain constituents of the blood or serum.

Dr. Hans Meyer has controverted the generally accepted opinion by asserting that the real cause of the irritating effects of para dyes is their extreme alkalinity, which can be remedied by partially neutralising the free base with suitable acids.

" To remedy (the toxic effects of para) it is neutralised by means of acid materials, but it is essential for one of the amino groups to remain free, in order that the tinctorial powers of the dye may not be diminished. One molecule of diamine, therefore, is combined with one molecule of a monobasic carboxylic acid. The following combinations may be employed : salicylic acid and *para*-phenylene diamine (intense black), salicylic acid and *para*-toluylene-diamine (dark brown), gallic acid and *para*-phenylene diamine (chestnut brown), etc., other possible combinations being salicylic acid with *para*-amino-diphenylamine, and benzoic acid, *ortho*-nitro-benzoic acid, acetic acid, and lactic acid with *para*-phenylene-diamine. The colouring powers of these combinations are perceptibly equal to those of the free diamines ; whereas, chemical experiments and dyeing tests carried out on animals and human beings have shown that, from the physiological point of view, the combinations are harmless." *

---

* Quoted from a report by Dr. Ch. Wilkie, *Chimie et Industrie* (1929), Vol. 22, p. 1237. For Dr. Meyer's original paper, see *Chemiker-Zeitung* (1929), Vol. 53, pp. 765–766.

Experiments by one of the present writers, however, have not confirmed these results, so far as the effectiveness of the dyes are concerned. The combination of *para*-phenylenediamine with salicylic or benzoic acids, in the proportions suggested, was found to exercise a very marked effect in reducing the tinctorial powers. Some not unpleasing results, so far as lighter tints were concerned, were, however, obtained with bleached hair. The authors are not in a position to confirm or to deny the claim made that the procedure in question destroys the toxic action of the dye, though, in view of all previous knowledge concerning the action of para, that it should do so seems unlikely.

PLATINUM BLONDES *

As every hairdresser knows, it is very rare for naturally white hair to be perfectly white. Too often a yellowish tinge is present, which gives the hair an unpleasant, dirty appearance. This can be remedied by rinsing the hair with water in which a little blue colouring matter has been dissolved. In Part III., Chapter IX., the process has been described so far as treating bleached postiche is concerned, and the use of a mixture of methyl violet and malachite green suggested. It is based on the well-established scientific fact that yellow light and indigo-blue light combine together to produce the effect of white light.

Similar treatment can be applied to living hair ; and by an extension of it, the " platinum blonde " effect can be obtained. The colour of the hair is first bleached to the palest blonde, and a blue rinse is then applied.

It is well known, however, that if a blue and a yellow pigment are mixed, the result is not white, but green. This is because there is, in this case, not addition of colours, but subtraction. The blue pigment absorbs almost entirely the yellow and red light, while the yellow pigment absorbs almost entirely the blue and violet. Hence, only the green remains.

It follows, therefore, that if the hair treated with a blue

---

* See Redgrove : " Le Blond ' Platine,' " *La Parfumerie Moderne* (1932), Vol. 26, pp. 173–179.

rinse is of a more decided yellow than the palest blonde, or if the rinse is too strong, the result may be, not the desired platinum blonde, but green !

While, therefore, dyeing hair platinum blonde may be very simple in theory, considerable skill and a nice judgment are called for if satisfactory results are to be obtained in actual practice.

The platinum blonde vogue originated in America, and became very popular in Great Britain in 1931. In the following year, a reaction set in ; and, to-day, hairdressers are rarely called upon to carry out this type of dyeing. The reason is that the bleaching required is so excessive that the hair suffers in consequence. Moreover, once the effect has been created, it cannot be undone, short of dyeing the hair, a process not too easy because of its weakened condition. The wearer who desires a change must wait until new hair has grown. In the meantime, she presents a freakish appearance.

On the other hand, the platinum blonde effect suits some women very well ; and may be recommended when the hair is very faded or of an unpleasing dirty white.

The first stage in the process is very severe bleaching, conducted along the lines explained in Part III., Chapter V. It is imperative, however, to avoid excess of ammonia, as a reddish tinge is fatal to the success of the process.

A weak blue rinse is then applied, after the hair has been washed. Various dyes are used, including methylene blue and water-soluble nigrosine. Methylene blue (Colour Index No. 922) occurs in the form of a dark greenish crystalline powder or in that of crystals with a bronze-like lustre. Chemically speaking it is the chloride or double zinc chloride of tetramethyl-diamino-diphenazthionium. The form containing zinc should not be used, but only the pure chloride. It dissolves in water to give a blue solution.

The substance has been used in medicine, but is said to be of doubtful utility as a drug. In large doses it is very irritant.

Water-soluble nigrosine is a black, rather than a blue dye. It is prepared from spirit-soluble nigrosine by a process of sulphonation which considerably modifies its character in certain respects. Spirit-soluble nigrosine must not be used. Pure water-soluble nigrosine is considered to be of so innocuous a character that its employment as a colouring matter for foodstuffs has recently been sanctioned in some of the Australian States, where only specified dyes are allowed for this purpose.

Water-soluble nigrosine (Colour Index No. 865) occurs in glistening black lumps, which dissolve in water to yield a bluish violet solution. When strong, the solutions look practically black.

Water-soluble nigrosine gives a silvery effect rather than a platinum one, and is rather less satisfactory in use than methylene blue. It may, however, be used in conjunction with the latter, a variety of pleasing effects being thereby obtainable. If stock solutions of the two dyes are prepared, these can be diluted as occasion demands, or mixed together in various proportions. In any case, the colour of the rinse should be quite pale. The addition of a little lemon juice or tartaric acid to the rinse has been recommended.

INDEX

(The names of authors quoted or referred to are printed in small capitals.)

PRINTED IN GREAT BRITAIN BY THE WHITEFRIARS PRESS LTD.
LONDON AND TONBRIDGE