N.B. Galvanism was known in ye year 1700 as is clearly proved by the Transactions of the Philosophical Society of Paris for that year.

Augt ye 18th 1804. —

THE
PAINTER AND VARNISHER'S GUIDE;

OR,

A Treatise,

BOTH IN THEORY AND PRACTICE,

ON THE ART OF

MAKING AND APPLYING VARNISHES;

ON THE

DIFFERENT KINDS OF PAINTING;

AND ON

THE METHOD OF PREPARING COLOURS

BOTH SIMPLE AND COMPOUND:

WITH NEW OBSERVATIONS AND EXPERIMENTS ON COPAL; ON THE NATURE OF THE SUBSTANCES EMPLOYED IN THE COMPOSITION OF VARNISHES AND OF COLOURS; AND ON VARIOUS PROCESSES USED IN THE ART.

DEDICATED TO THE SOCIETY AT GENEVA FOR THE ENCOURAGEMENT OF THE ARTS, AGRICULTURE, AND COMMERCE.

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ILLUSTRATED WITH ENGRAVINGS.

LONDON:

PRINTED FOR G. KEARSLEY, FLEET-STREET,

By J. Taylor, Black-Horse-Court.

1804.

AUTHOR'S PREFACE.

The Society established at Geneva for the Encouragement of the Arts, Agriculture, and Commerce, charged its Committee of Chemistry to take into consideration those arts of which no methodical descriptions had been given by the Academy of Sciences at Paris. It was, indeed, intended by the Academy that the art of varnishing should form a part of their collection; and de Machy, one of the members, had, I believe, prepared some materials for that purpose, but on the publication of Watin's work in 1772 he seems to have abandoned his design.

This art, which is of modern date in Europe, notwithstanding the assistance thus given to it by Watin, still required that the principles on which it is founded, and by which it can be carried to perfection, should be more fully explained and illustrated. Every thing that relates to the history of the colouring parts, and to the operations which make them appear with their true properties, has in that publication been either omitted or neglected. The Committee of Chemistry, in consequence of some observations which I had made on the arts in my public or private lectures, were of opinion that a new work on this subject would form a valuable and even necessary addition to that of Watin: they conceived also, that as this art is one of those which are entirely founded on chemistry, it ought to be treated according to the modern system. I engaged to undertake this labour; and I now present the result of it to the public, with the approbation of the Society to whom I have dedicated it.

INTRODUCTION.

Though it is commonly supposed that painting in oil was not known before the fourteenth century, it is probable that the antients employed it for ornamenting their porticoes. The fragments of painting with which the fronts of some of the edifices discovered among the ruins of Herculaneum and Pompeia are still decorated, and which have escaped the ravages of time, and the impression of the volcanic ashes under which they were buried, appear to me sufficient authority for this observation.

But the wars which hastened, and those which followed, the fall of the Roman empire; the almost general devastation which was the result of them; the conversion of polished nations, by a series of calamitous circumstances, into Goths and Vandals; and the ages of barbarism which succeeded, dissipated the last traces of industry and of the progress of civilization; changed or corrupted every thing, and even the language of the subjected nations, which a state of oppressive servitude reduced and accustomed to the mere necessaries of life.

Those accumulated scourges to which Europe was exposed were, however, confined within certain limits, by that desire which men have for peace when nothing more remains for them to destroy; and by that peace itself, which gradually restores them to the use of their reason, and brings them back to the dignity of their nature. Their physical strength is then employed in seconding the efforts of the imagination and of genius. Their thoughts are employed on new objects; discoveries are multiplied; commercial intercourse is re-established between nations; the wants of society are enlarged in proportion to the extent of this communication, and a desire of enjoyment increases. All these effects, the result of a more settled state of government, soon tended to ameliorate agriculture; to improve the necessary arts; to extend those which contribute to heighten the comforts of life; and to call forth those sciences which form the chief glory of nations.

It is, no doubt, unfortunate that the scourges which, during the different convulsions among mankind, poison in this manner all the sources of public happiness; which fall heavily on enlightened nations, and either disperse or entirely destroy them, should leave to their successors only fragments that have escaped the general devastation. The sciences disappear with men of talents. It then becomes necessary to open new routes on a degraded soil, and the genius which advances in the career of discovery often arrives, after much labour, at results of which anterior ages have left some faint traces. Every thing connected with the secrets of industry would, no doubt, have been saved, had the valuable discovery of those processes which constitute the art of printing preceded that of the mechanical arts.

It appears almost certain, that the varnishes which have been made and employed for many centuries by the nations who inhabit the eastern parts of Asia were in part known also to the Romans. The ruins of Pompeia remove every doubt in regard to the use which these people made of oil painting to ornament their buildings. Some pieces of their copper coin, struck under the reign of Trajan, and dug up from antient ruins, are covered, as Count Caylus remarks, with a kind of resinous varnish, similar to that which would result from a mixture of oil and black pitch*. If the

* It is not possible to conceive what advantage could result from the application of a coarse varnish, which deprived the coin of its metallic splendour, and destroyed the relief of the impression, which displays the talents of the engraver, and gives an ideal value to coins.

antients were ignorant of the art of grinding, mixing up, and combining oil colours, which, however, there is no reason to suppose; and if they did not carry to such an extent as the moderns those mechanical processes which assist painting of the first kind (that of pictures), it cannot be doubted that the Greeks, in particular, were acquainted with the art of giving lustre to the colours which they employed in their fine compositions, and also of preserving them.

The names of a Timanthes, a Zeuxis, an Apollodorus, a Polygnotus, a Pausias, and a Parrhasius, who by their warm compositions added lustre to the ages of Pericles and of Socrates; who combined grace of disposition with brightness of colouring; boldness of design with mellowness of execution; and who produced masterpieces which exist only in the descriptions transmitted to us, show how great were the losses which followed the destruction of liberty among the Grecian republics. Their means, without being so extensive as ours, were sufficient, according to the expression of Parrhasius, to give their compositions as much solidity as enabled them to withstand the influence of the air.

It is well known that oily or resinous matters were much employed among the Romans. The use of perfumes, sepulchral lights, and flambeaux, was very extensive in their public and private ceremonies. A resinous kind of cement was much employed also by these people in building. It is, therefore, probable that the conflagrations by which Rome and so many other fine cities were destroyed, and the revolutions of which Italy was the theatre, may have been the real causes of that resinous incrustation observed on some of the Roman copper coins dug up from antient ruins. It seems to be probable also, that similar accidents, by which various matters were mixed in confusion and buried for so many centuries, may have given rise to that *patine* so much esteemed by antiquaries, which they seek for on certain coins, and which seems to be merely a production of time. The decomposition of water, and the oxidation which is a certain result of it, are, no doubt, the principal causes of the formation of this crust, or smooth and sometimes shining paste, which is so gratifying to the eager eye of the antiquary.

But were Apelles, Protogenes, and Aristides, who succeeded to the glory of these early painters, and who in some things even surpassed them, better acquainted with the art of preparing colours, and the means of giving them more body and more solidity?—If the preservation of the colouring was owing to a varnish, or to substances capable of making a varnish, did they mix them, as some modern painters do, with the colouring parts, even when distributed on the palette?—or did they reserve them to be applied to the composition after it was finished?

There is no monument in existence which can enable us to resolve these questions. The masterpieces of Apelles, and those of the painters who preceded him, disappeared with the generations who saw them produced. Gum water and white of egg, which are still employed for certain pieces of painting, were not perhaps neglected. Being ill calculated, however, by their nature to resist the impression of moisture, and the washing rendered necessary in consequence of their being dirtied by insects, they could not be any security to artists that their works would be handed down unimpaired to posterity. The mixture of oils and resins, and that of resins with alcohol (spirit of wine), which form real varnishes, are alone endowed with the valuable property of checking the ravages of time. Since no trace of the compositions of the antient masters remains, there is reason to presume that our means were unknown to them; or that they employed processes less effectual; or that their works were condemned to the same fate as so many other productions of human industry, and were lost in the wreck of time.

If we even suppose that the Greeks had acquired by their commercial intercourse some knowledge of the Chinese varnish, they could not apply it to their fine paintings, both on account of the consistence which that varnish is known to possess, and of its colour, which must have presented an obstacle still more insurmountable.

The same Greeks, however, were in possession of a kind of painting which was attended with the advantage of braving the influence of the air and of the sun, and of not being subject to those reflections of light which render it necessary that oil paintings, to be seen with advantage, should be placed in a particular situation; I here mean encaustic, or painting in wax, which was lost, and which was revived by two celebrated men in the last century.

Vieu, a very ingenious painter, to whom the fine arts are under great obligations, made an attempt, under the auspices of Count Caylus, to paint in this way a head of the Virgin, which was engraved in the chalk manner. Encaustic found a no less enlightened protector a few years ago in Counsellor Rafelschtein. Some Italian artists, assisted by his advice, and by the encouragement which he gave them, executed several paintings of this kind, which obtained the approbation of connoisseurs.

Encaustic painting possesses more strength than that in distemper. Its uniform mellowness produces more harmony in the tones, which the spectator readily catches in every position. This method of painting does not admit of any kind of varnish applied after the work is finished. Wax, which is the essential basis of it, and which combines exceedingly well with the colours, becomes the cause of the consistence and pliableness of the painting, when it has received from a pretty strong heat that *inustion*, which makes it penetrate into the canvas. The canvas, when it has thus imbibed the wax, exhibits a thin flexible stratum, which is nevertheless susceptible of a very fine polish.

Nothwithstanding all those kinds of degradation which the fine arts experienced under the Lower empire, and particularly towards its fall, Greece might, perhaps, still boast of masterpieces of encaustic, from the hands of Polygnotus of Thasos, had they not, after nine centuries of admiration, become a subject of envy or emulation to one of the Roman prætors, who caused them to be transported to the capital of the world, where they shared in the fate of so many other valuable monuments of antiquity.

All the arts approach each other in more or fewer points, and in a manner more or less perceptible. This affinity is more sensible in the mechanical arts, which are employed on objects of the first necessity, than in those the principles of which depend on the progress of civilization, and which require a knowledge of combinations, and an intimate acquaintance with the materials which they consume or which they modify. A knowledge of the analogies discovered between certain resinous substances belongs to the analytical part of chemistry: it consequently comprehends a long series of processes; and it does not appear that this science, which led to the discovery of varnish, formed a part of the serious occupations of the Greeks.

The greater part of the mechanical, and we may even say of all the arts, began to be attended with conspicuous success only at that period when the facts relating to them were sufficiently connected to admit of their being formed into a theory. This assertion, which might be generalized, is more particularly applicable to those arts which depend on the effects of chemical combinations. At every step obstacles occur; every thing appears new and strange; and inconstancy in the results of experiments, often intrusted to chance, discourages in enterprises which the least knowledge of theory would render successful. It may readily be believed that the discovery of varnish was the fruit of repeated trials; and though those who made them had continually in their hands the essential materials, there was still wanting a motive, which was soon created among peaceable and industrious nations, by a taste for luxury, and by commercial communication.

But, if a knowledge of the theory which is now applied to certain manipulations in the arts, founded on the employment of chemical combinations, is deduced from a great number of leading facts, so intimately connected with these manipulations that they are a necessary and even expected result of them, the cause of them would, perhaps, have remained long unknown, without the influence of societies established for the purpose of exciting and calling forth the energies of the human mind. The public respect attached to these associations of learned men and artists distinguished by their merit, and still more the support of governments, which promote experiments and enterprises that require encouragement, have contributed not a little towards those interesting discoveries for which the present period is celebrated.

In regard to painting, some of the happiest results arising from these associations were, that the study of history was facilitated to young artists; that they were surrounded, in some measure, with masterpieces of the old painters; that their judgment was exercised with respect to chasteness of execution, propriety of arrangement, and correctness of design: this was rendering them familiar with real beauty, and inspiring them, at length, with the genius of the Greeks.

This genius, which among the Athenians in particular was exalted by the establishment of liberty, which was kept in full activity by commerce, and to which a spirit of enterprise was communicated by prosperity, necessarily raised them above that simplicity of manners by which nations who apply to agriculture, to those arts which are purely mechanical, or to a pastoral life, are characterized. This genius was formed to direct taste, to create it even, and to soar to the sublime in all its great conceptions. This was the case at Athens by the intercourse which the Greeks kept up with their neighbours; the latter were made to participate in their glory. The fine arts have their conquests; and these conquests are the more certain as they become mingled with, and increase, our dearest enjoyments. They produce emulation; and conduct, by a sure path, to that taste for *real beauty* which announces the progress of civilization.

In tracing out these grand effects, one is naturally led to inquire into the cause which produced them. This cause we can look for only in that rational liberty which inspires men with the desire of employing all the resources of their talents; which, by an insensible gradation, raises one individual above another; which induces them to divest themselves of all envy on account of merit different from their own, or which surpasses it; and which makes them seek happiness in a continued intercourse with virtuous citizens, whom the public opinion has invested with respect. Such was the use which Athens made of her liberty during the period of her splendour: it was in this manner that plain citizens, but distinguished by particular talents, concurred to produce those important results with which the interests of nations are so intimately connected; which raise them into notice, and which turn to the greatest benefit of mankind the intercourse they maintain with others.

The Greeks, in consequence of their republican institutions, were able to extend much further those advantages which we make to depend on different learned societies, such as those established in Italy, in France, and in other countries of Europe. Their progress, therefore, was much more rapid than ours, and their enterprises were more marked with grandeur. We are indebted to them for all the splendour displayed by the fine arts among us; but unfortunately we do not yet possess all their riches.

But, in matters of government, the best institutions are not sheltered from the instability attached to human affairs. The prosperity of the Greek republics was soon blasted by their intestine divisions. The fine arts languished, and seemed to expire along with the flame of liberty; and if the intercourse afterwards renewed between the nations of antient Greece, and those of Asia and India in particular, by the conquests of Alexander the Great, seemed to revive the arts in their antient country; if it seemed to recall the flourishing periods of a Pericles; it was only, as we may say, to afford an opportunity of collecting those valuable materials which Italy and other countries were afterwards, in some measure, to naturalize and to improve.

The Thebaid, the most remote part of Egypt, which is now a desert, notwithstanding the ravage of time, still attests the influence of the fine arts of Greece on the people of that country. It would appear, from the recent observations of some travellers who visited the ruins of Thebes, that the antient inhabitants of this country were well versed in all the branches of design and of painting. If the freshness which still characterizes some fragments discovered in antient galleries buried amidst ruins, seems to prove that the painters were then acquainted with the same means, or others equivalent to them, which the modern painters employ to preserve their works for posterity,—this circumstance must afford new motives for applauding the wonderful discovery of the art of printing, which becomes the most certain safeguard to the productions of the human mind against that spirit of devastation by which all conquering nations are animated.

I have already observed, that a state of peace in a nation which has been agitated by long convulsions has a much greater influence on the arts than any other circumstance depending on its particular genius. The Chinese, situated in the extremity of Asia, seem to form an exception to this remark, the justness of which in regard to the freer nations of Europe can be better appreciated. Among the former, the uninterrupted exercise of their arts is never extended beyond habit and routine; but it corrects, to a certain degree, the faults which arise from their aversion to imitation. They are never excited by a spirit of emulation. The son becomes the servile copyist of the works of his father: he has no idea of improvement; and while manipulations are thought to be every thing, theory is neglected. This is clearly observed in the methods which the Chinese pursue in the application of their lakes; in the style of their painting; in the forms which they give to the different articles of their manufacture, and which appear to be as immutable as their empire. Their transparent varnish is composed of two substances only. The addition of common colours, without variation, constitutes their different lakes; and the physical properties of these two substances contribute more than art to the solidity of their compositions. If the nations of Europe, and particularly the French, had found in their territories the natural production which supplies the Chinese with the principal ingredient of their varnish, solidity combined with elegance of form; highly finished painting, delicacy of design, and splendour of colours, would have soon made the art of the varnisher and painter be considered as one of the first sources of national riches, in consequence of the extent it would have given to various branches of commerce.

But the spirit of imitation, strengthened by the knowledge acquired in regard to chemical analysis, at length naturalized in France an art which seemed to be confined to the remotest parts of Asia. The observations of the Jesuit missionaries on certain arts cultivated by the Chinese, and on some of the most important branches of their industry, excited a spirit of emulation among artists, and induced them to repeat the processes of their inventors; to supply those deficiencies which might arise from want of sufficient information, in consequence of the reserve which forms a prominent feature in the character of these people;

and to correct those faults which might proceed from a difference in the substances employed*. The publicity of these observations marks out the period of our enterprises and success in a new series of processes before unknown; and the execution of them, whether servile imitations or modified according to the ingenuity of the artists, seemed to be so much connected with our enjoyments, that there was reason to conclude the result would be a sufficiency of materials and information to enable artists to subject the mechanical processes to correct principles, as well as invariable rules; and to add a new art to those already known.

In the year 1737 such a spirit of emulation was excited among the French artists, in consequence of some models or varnished articles brought from China, and such an enthusiasm for imitating this varnish, which was represented as being unalterable in the fire, that people were almost disposed to prefer varnished to metallic vessels.

The dreams of the credulous alchemists were not entirely useless to the chemists who succeeded them: in the same manner, this ephemeron enthusiasm was not lost to society. The imagination, when it dwells for a long time on one object, will at length arrive at some valuable discovery. These attempts to obtain an incombustible varnish gave birth at length to a new art, which was the more lucrative to France as it has not, like so many other objects, experienced the effects of the inconstancy of taste. I here allude to the art of making varnished paper snuff-boxes, &c.

Among the artists employed in this new branch of industry, there was one for whom it was reserved to extend its limits, by applying it to objects of luxury of the highest importance. The celebrated Martin, being furnished with good compositions of varnish, soon combined the two kinds

* See *Lettres édifiantes et curieuses* published by the Jesuits. The details of Father d'Incarville respecting the Chinese varnish may be found in the *Mémoires des Savans Etrangers*, vol. iii.

of painting. He called in to his aid the art of the gilder, and gave it that importance which always arises from the wants of the public. In a word, all the arts belonging to coach-making received from it an assistance the more certain as they all depend on an inexhaustible source, namely, a taste for show, to which the opulent sacrifice every thing.

An art so fertile in resources could no longer be confined to external objects of luxury. A taste for the decorations applied to apartments, during this continued and progressive improvement, was extended from palaces to the habitations of the rich, and by the effect of imitation was transferred thence to the humble abode of the citizen in easy circumstances.

The processes, however, employed at this period were agreeable to the experience of artists who had been engaged, for the most part, in those simple operations used for painting in distemper. The most intelligent confined themselves to a series of processes for which they were indebted to particular researches, or to communications from amateurs distinguished by their fortune or their knowledge, or which they obtained from venders of secrets, a kind of people who are very common in professions founded on chemical operations. Each process, therefore, bore evident marks of the ignorance or inexperience of the artist. Hence the differences observed in the colouring, brilliancy, consistence, tenacity, or dryness of the varnish employed. The operator, too easily satisfied with his first attempts, proceeded no further in the improvement of his art. The secret was the more strictly observed, as it seemed to secure a certain resource to the industry and family of the possessor. Hence also that incoherence in the formulæ which different works seemed to confirm, and which they extol as the properest for answering the intended purpose. Hence, also, that immense collection of obscure recipes, said to be derived from the best sources, which artists of ability soon condemn, because they find them at variance with the true principles of the art. The works intitled *Les Secrets des Arts et Metiers**, *Le Dictionnaire des Arts, L'Art du Vernisseur, Le Parfait Vernisseur,* and other small essays of this kind, abound with faults, arising from the bad choice of the editors, and which deprive them of the merit attached to good elementary works, and to methodical descriptions of the arts.

The interest of the practitioner, therefore, raised a barrier which prevented the art from approaching towards theory. It was, however, necessary that the latter should become the basis of all future researches, in order to throw light on the different processes, to ascertain the nature of the results by a rigorous comparison, and thus to establish the real principles of the art. This happy effect was, in part, produced by the public spirit of an artist who was so generous as to disclose some processes which I here propose to examine, presenting them in a new order of distribution, and adding the necessary observations.

Watin, to whom I here allude, did not forget the interest of the artist when he intrusted his precepts to the writer charged with preparing them for the press. But while he reserved the secret of certain processes, which were his own, he did not observe that by contributing to reduce the art to certain principles, he at the same time prepared means for lessening its difficulties, and of enabling artists to arrive speedily at that happy period when all reserve becomes use-

* A work in four large volumes, with the attracting title of *Secrets concernant les Arts et Metiers*, was published a few years ago. It is a crude compilation of all the processes with which the different periods of the various arts on which it treats have been encumbered. The art of varnishing occupies a whole volume, which contains, without choice, every thing, good or bad, relating to it. One may readily perceive that it is more calculated to mislead the artist amidst a labyrinth of contradictory formulæ, than to guide him in his progress by a series of principles which might enable him to banish every thing foreign to the main object of his researches.

less or ridiculous. Had he laid open all his processes, he would certainly have acted more consistent with those principles by which he seems to have been guided.

Notwithstanding his reserve, which displays in a striking manner the spirit by which even the most experienced artists are influenced, his work will always form an epoch in the art of varnishing. He unites in the same point of view a series of practical precepts founded on long experience, and which have hitherto been followed by the most intelligent painters: but the greater part of those who in country places exercise this profession are guided in their operations by a faulty routine. Whatever treatise may in future be written on this useful art, it can only clear the path, which this author has in some measure traced out, from the shackles which real theory always imposes on the artist who is merely a manipulator; and no addition in this respect can in any manner lessen the favourable opinion with which Watin's work was received. With this spirit I undertook to review a subject which has been treated by various authors, considering it under its different aspects, combining it with every thing reserved for it by the new chemistry, and with many other arts which seem to require from it a new support.

It is much to be wished that this devotion to the public interest were more imitated by artists of every class; but particularly by those whose manipulations depend on chemical mixtures or combinations, as in the manufacturing of printed cottons, the art of making paper hangings, in dyeing, &c., the various formulæ of which are scattered among the conductors of manufactories. These processes, which for the most part have been the fruit of some accidental circumstances, would soon experience, by the free concurrence of artists and chemists, advantageous modifications which would lead to new discoveries. Society would thus be enriched with good descriptions of the arts;

and these would add to the great importance attached to those valuable collections published by the ci-devant Academy of Sciences at Paris, in regard to objects which have a powerful influence on the happiness and prosperity of empires.

It is not my intention to follow the art of the varnisher through all the details which may seem suited to those artists who are more particularly employed in the decoration of carriages and other objects of luxury. I shall more immediately confine myself to an illustration of the principles. These alone are applicable to all circumstances in which the painter and varnisher are interested. They will lose nothing by being condensed: and if they conduct the pupil and amateur, by a sure path, to that eminence from which they can see the extent of the art, they cannot be foreign to those complete artists who, by their talents and their masterpieces, contribute to feed the luxury of large cities.

My object is to place in a conspicuous point of view every thing that can assist the varnisher and painter in regard to matters which fall within the province of their profession; and, in some measure, to conduct the amateur by the hand.

The composition of varnish is connected with a particular kind of knowledge respecting the physical and chemical properties of the dry or liquid substances which form its constituent parts. The study of these objects must induce artists to follow them in the effects which arise from the extreme division they experience, when brought into contact, according to certain laws. The kind of chemical phænomenon which takes place in the latter case depends, then, on rules and precepts established by experience. The art is gradually enlarged by all those parts which seem to have a coincident relation. Painting in distemper preceded the discovery of painting in oil; and the latter was some years anterior, as appears, to the invention and application of varnish. These three parts touch each other in inseparable points; but they have each their distinct rules, and are sufficiently rich in matters to justify the appropriation of one division of the work to a particular description of them. I have, therefore, been induced to divide this treatise into two parts.

The first comprehends an historical account of the dry or liquid substances which concur towards the composition of varnish.

The ingredients employed in the different compositions of varnish are described, in general, in works which form no part of the libraries of pupils or of artists. I therefore considered it my duty to introduce this subject, to banish from it all those articles which are foreign to the art, and to subjoin such observations as I thought useful, because they appeared to me proper to excite a taste for study, to facilitate instruction, and to concur in a direct manner to produce that body of information which is expected in a methodical work.

It was necessary that an examination of the dry substances should be followed by an account of the different fluids employed as excipients or vehicles in these compositions. A mere nomenclature would not have excited that interest which the study of them requires: the case, however, is different when they are exhibited under all those relations which tend to make known their nature, their particular properties, and the modifications resulting from the preliminary preparations to which they are subjected.

I then proceed to general observations on varnishes; which are followed by a distribution of them into two classes. The latter of these, or that which I have here chiefly in view, is subdivided into five genera, each containing a certain number of species, or particular kinds, which are admitted into these genera according to their nature, their consistence, and the properties of their component parts.

This division, which is well calculated to facilitate a knowledge of them, is followed by an examination of general precepts in regard to the composition of varnish on a large scale. The object I had here in view could have been answered only in an imperfect manner if, in following all the details of the manipulations, I had neglected the means of rectifying them, in such a manner as to secure artists from those serious accidents with which these operations are often accompanied. I conceived that the use of an alembic of a new form might facilitate that rotary motion which must necessarily be given to the matters inclosed in it, and at the same time prevent those inconveniences which arise from the too sudden tumefaction or evaporation of the inflammable liquid.

It was necessary, also, that I should communicate to artists some observations, which are still more particularly my own, in regard to the solution of copal in essence of turpentine, a fact contested by Watin, though it seemed to be proved by some experiments of Lehman. The secret cause of this difference of opinion deserves to be known, as well as every thing that can facilitate the use of copal varnish made with essence or with ether.

If the first part of this treatise is destined to make known the substances which concur to the composition of varnish, as well as the processes by which artists are enabled to give them the requisite properties, the second, which contains an examination of the colouring substances, and of every thing that relates to the different branches of common painting, can be no less interesting to the artist and the amateur. After describing these substances, I proceed to observations which seem to arise from the subject; such as those on the origin of colours, and on the particular processes which enrich the art of varnishing with a great number of colouring substances, not always furnished by nature in that state in which the painter employs them. The artist is then presented with some particular results which may encourage him to give greater extent to the use of certain varnishes proper for repairing enamelled articles damaged by accidents. These varnishes are attended also with another advantage, that of favouring a new kind of manufacture, which may be distinguished by the name of false enamel, or enamel by varnish.

In describing the different preparations, the reader will be conducted from the simple to the compound. He will be enabled to follow the transitions from the lightest colours to those which, with the same varnishes, borrow from the nature of the colouring substances modifications of tints, well calculated to enlarge the ideas he may have formed in regard to the richness of the art, and the extent of the resources it displays by the efforts of genius, when destined for the sublime kind of painting.

It is not sufficient that artists should know how to prepare or to procure the colours or varnishes which they intend to apply to any article: they must know also how to make use of them. This department of the art has its rules and precepts, which must be studied or consulted when the colours employed are destined for distemper, for varnish, or for oil. This object is of as much importance as that of composition, and required to be treated separately.

I have taken advantage of some particular experiments to give an account of several processes belonging to a branch of manufacture which has a direct relation with the subject of this work, and which, as far as I know, has never yet been described: I here mean the art of making wax cloths (oil cloths).

This order in the distribution of the matters to be treated of would not have entirely answered the proposed purpose, had I omitted to describe, according to the principles of the pneumatic doctrine, such objects as are susceptible of it. There can be no doubt that this part of the work will be that least acceptable to the artist who through habit is unwilling to give up his old nomenclature. But persons in the least familiar with this language will find full compensation in the satisfaction which accompanies an examination of the physical and chemical properties of the substances I shall have to describe, and in the historical account of the changes produced in them by art. I shall, however, still keep in mind, that I ought to confine myself to those points which justify the changes prescribed by the present system of chemistry in the common expressions employed to distinguish them. The addition of the terms established by the new nomenclature, to those which are familiar to them, will gradually accustom artists to adopt them readily without any loss to the art.

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PART THE FIRST,

CONTAINING

AN ACCOUNT OF THE SUBSTANCES USED IN MAKING

VARNISHES,

AND

THE METHOD OF PREPARING THEM.

TREATISE ON VARNISHES,

&c.

PART THE FIRST.

CHAPTER I.

Historical account of the nature and properties of the substances which form the basis of varnishes, and of the external qualities by which the best kinds may be known.

ASPHALTUM.

ASPHALTUM is a bituminous substance, which in some countries is very abundant. The Peruvians, and in particular the Egyptians, formed it into a paste, and filled with it the cavities of those dead bodies which they were desirous of embalming. They gave to it also, by the help of certain mixtures, the consistence of varnish, and dipped in it the cloth which they wrapped round these bodies after they had been embalmed.

This substance is a kind of mineral pitch, susceptible of acquiring a certain degree of consistence. The principles of its composition appear to be different from those which distinguish certain artificial kinds of pitch, resulting from the spontaneous or accidental decomposition of a vegetable substance of an inflammable nature. Asphaltum seems to participate a little in animal matter.

It is of a black colour, the tone of which is not uniform. Sometimes the surface of the pieces exhibits a capuchin black, while the interior is darker and glossier. It is employed, under certain circumstances, by painters in oil-colours, though its application in this kind of painting has by some been condemned. In common painting it is admitted into the composition of black lakes, and mixtures destined for coloured grounds, and for representing articles of iron: it is, however, rarely mixed with other substances. When employed, it is dissolved over a slow fire with prepared oil, until the result is a pretty thick liquid, which, when a rod has been immersed in it, runs from it as oil would do, and not at intervals or in separate portions. It may be readily conceived that this circumstance will depend on the proper proportions which must be observed, in the respective quantities of the two ingredients.

Asphaltum issues in a liquid form from the bottom of the lake Asphaltis in Judæa; and hence the name of Jew's pitch, which is given to it. It rises to the surface of the water, where it is dried by the combined action of the sun and of the air.

To be good, it ought to be solid and brittle; to have a brilliant surface as if polished; and to be almost black. If fragments of asphaltum, formed into thin laminæ, be held between the eye and the light of a candle, the colour of them appears to incline to red. When cold it emits very little smell; but when inflamed it has a strong, penetrating, bituminous odour.

It is often adulterated with pisasphaltum, another kind of bitumen, less solid, the odour of which holds a mean rank between that of pitch and that of bitumen.

BENJAMIN.

Benjamin is a hard, dry, brittle, inflammable substance, of a resinous taste, and which when thrown on burning coals emits a sweet penetrating odour.

It results from a resinous sap, which distils by incision from a kind of *badamier* very abundant in some parts of India; on the Malabar coast, and particularly in Cochinchina, and in the islands of Sumatra, Java, &c.

When this resin is fresh it has the consistence of a balsam, such as it is seen in turpentine; it then gradually thickens, and forms white tears, which are combined with other tears more coloured, either by the impression of the light, or by mixture with some part of the bark of the tree, or with dust driven about by the winds. This mixture of white tears, which the brownness of the mass renders still more striking, makes the whole have the appearance of *nougat**, containing portions of peeled almonds; and hence the name of *amygdaloid* given to this benjamin in commerce, to distinguish it from a more common kind of a fawn-colour, which is mixed with saw-dust, seeds, and other impurities.

By sublimation, without any intermediate substance, and even by simple ebullition in water, benjamin furnishes a salt which assumes the form of snowy flakes, in consequence of the union of small tufts of very light argentine needles, exceedingly odorous, which to the taste manifest a remarkable principle of acidity.

* *Nougat* is a kind of preparation made in France from almonds.—T.

This particular salt, which forms the essential character of balsams, is foreign to the composition of varnish. Benjamin ought to be chosen with as little colour as possible; and if purity be required in the varnish, it will be proper to employ only the white tears.

Benjamin readily dissolves in alcohol (spirit of wine), and forms a tincture charged with a reddish colour. This tincture, under the name of *balsamic milk*, makes part of the formidable apparatus of the toilette.

Benjamin, when in this state of extreme division by means of alcohol, forms a varnish of an agreeable odour, which retains a considerable degree of tenacity, and belongs to those kinds which are slightly coloured*.

CAMPHOR.

Camphor is a light vegetable substance, in part friable, transparent, slightly unctuous, and of a very strong aromatic odour. It has a bitter and highly acrid taste, though it at the same time occasions a sensation of cold.

It dissolves entirely and with great facility in alcohol (rectified spirit of wine). It combines with oils both fixed and volatile; it readily inflames and burns even on water, over which the part liquefied by the heat extends, in consequence of its great lightness, and forms a kind of bason, or crater, the circular edge of which, being cooled by the water, remains solid. As this kind of circumvallation preserves the centre from immersion, the camphor continues to burn, even below the level of the water. The flame is accompanied with a fuliginous smoke.

* See the second kind, No. 7, in the First Part.

It appears that no certain opinion has yet been formed in regard to the rank which camphor ought to hold in the order of vegetable substances. Naturalists consider it as a resin; but most of the chemists class it among the essential oils. The arguments on both sides seem to rest on a pretty solid foundation.

In camphor, indeed, we find particular properties, which facilitate a comparison, and which indicate, at the same time, that it participates more in the nature of essential oils than in that of resins.

1st. Like essential oils, it is volatilized at a degree of heat superior to that of boiling water.

2d. It dissolves entirely in alcohol. It combines with oils, both fixed and volatile, without disengaging heat and without leaving any residuum.

3d. When water is added to a spirituous solution of camphor, the whole of it, the aroma or odorous principle excepted, abandons the alcohol and floats on the surface.

4th. In burning, it disengages a fuliginous smoke, like essential oils, and leaves no residuum.

5th. Solution of camphor in alcohol gives, by distillation, a very abundant aromatic principle.

In this respect no resin can be compared to it. Resins are fixed in the fire; they do not entirely dissolve in alcohol; a solution of them, when mixed with water, forms a sediment; they burn more slowly, and leave a great deal of charcoal.

Camphor then appears to be of an oily nature. It would form a particular concrete oil, the origin of which does not seem to be attached to one kind of plants, since it is found in vegetable individuals of different families.

The camphor sold in the shops is extracted from a kind of laurel which grows in great abundance in the large islands of the East Indies, such as Sumatra, Borneo, Java, Japan, &c. This tree is distinguished by the name of the camphor laurel. The camphor of the island of Java is of the first quality.

The knowledge we have acquired in regard to the process employed to obtain camphor has been communicated to us by the Jesuit missionaries*.

The camphor is dispersed over every part of the tree: it is even often found under the form of small concrete laminæ. The peasants have a simple method of extracting it. They cut off the young shoots, branches, and roots of the camphor tree, and, having bruised them, boil them in water, taking care to beat the mixture with a kind of broom formed of small twigs. When they observe that these twigs are covered with a sort of white jelly, they conclude that the separation of the camphorous matter has been effected. They then take the vessel from the fire; leave the matter at rest for twenty-four hours; and at the end of that time separate the camphor, which is found coagulated into one mass.

This mass is composed of small balls, or grains, rendered impure by being mixed with fragments of bark, wood, and other foreign substances, which always accompany the first process on a large scale. The workmen, however, have a very simple method of purifying

* Lettres édifiantes et curieuses des Jésuites Missionaires à la Chine, 24me recueil, &c.

it, by means of sublimation with a sixteenth part of quicklime: but this purification is very inferior to that practised in Europe; for the Dutch, who have made this article a considerable branch of commerce, subject to a new sublimation the purified camphor which they import from India.

This substance readily evaporates, especially when in contact with the atmosphere. It is even volatilised in the close boxes in which it is contained. The upper part of these boxes becomes covered with a beautiful crystallization, which disappears and reappears according as the temperature of the atmosphere is higher or lower. Some have imagined that the contact of the air might be prevented by covering the camphor with flax-seed; but this method does not answer the intended purpose. The quantity of camphor thus lost by neglect cannot be estimated, but it is certainly very great. There is only one method of effectually preventing this spontaneous evaporation, which is, to put the camphor into wide-mouthed bottles well closed with cork stoppers.

The use of camphor for varnish is limited: too great a quantity would render it mealy. It possesses the property of facilitating the solution of certain resins, which are exceedingly refractory to the *dissolving* action of their appropriate liquors. Its union with copal is not easily destroyed: in this combination camphor loses its volatility, and the copal its hardness and consistence: the result at length is a small flexible mass, which retains a long time its elasticity. Camphor, however, when united in proper doses to other resins, gives toughness to the varnish, and prevents it from cracking. The weight of half an ounce or from five-eighths to a pound of alcohol must not be exceeded. The latter proportion is that suited to essence of turpentine.

This substance does not admit of any choice. It is circulated in commerce pure and without any mixture, and only requires to be carefully preserved.

CAOUTCHOUC, ELASTIC RESIN.

The physical and chemical properties of caoutchouc, or elastic resin, do not completely justify the latter appellation. Nothing indeed has less resemblance to a resin in its chemical properties, since it resists alcohol (rectified spirit of wine); nor is it a gum, since it is not soluble in water. These considerations are sufficient to make us admit the denomination of *caoutchouc*, which is given to this substance by the people who inhabit the banks of the river of the Amazons.

It is extracted, by incision, from a large tree known under the name of the *syringe-tree*, or *seringat*; and which appears to be very abundant in every part of South America. The Omaguas, one of those tribes who inhabit Popayan, form of the inspissated juice of this tree a kind of hollow elastic pears, which serve them as syringes. This circumstance explains the etymology of the generic name given by the Portuguese to the tree which furnishes the caoutchouc.

Though this substance differs in a great many respects from the particular properties of resins, it participates with them in an eminent degree in that of being inflammable. The American tribes know how to turn this property to advantage by converting the caoutchouc into a kind of tapers, two feet in length, and of the size of the finger, the flame of which emits a strong light, and lasts a long time.

This singular substance when taken from the tree is fluid. At first it is a white juice, susceptible of inspissation by exposure to the air, and particularly by a process peculiar to the inhabitants of these countries. When it has acquired a certain degree of consistence, they wrap it round wooden or baked earth moulds, and expose the moulds, covered in this manner, to the impression of a thick smoke. It is this smoke which communicates that brown or blackish colour observed in the caoutchouc imported to us under the form of pears. A temperature of from 75 to 100 degrees of Fahren. facilitates the elasticity, which is one of the most distinguishing characters of this substance; and indeed it is the most astonishing when we consider the extent of it.

Attempts have been made to apply this elasticity to new purposes of the utmost utility. Some have endeavoured to dissolve caoutchouc in certain liquids supposed to be fittest for that purpose; but though various processes have been employed to restore to it its former elasticity, after a careful evaporation, none of them has succeeded, except that of its solution in sulphuric ether. Macquer is the first chemist who made researches with a view to extend the utility of caoutchouc. He found that when dissolved in ether it experienced no modification capable of altering its elastic property. This ethereous solution poured on water deposits and extends the substance of the caoutchouc under the form of a pellicle, which may be easily removed by evaporating the ether. The elasticity of this caoutchouc is astonishing. If this pellicle be stretched over moulds it is capable of assuming every form, and of acquiring that state of consistence in which it appears after it has been subjected to this process. By these means it might be converted into boots and caps impenetrable to water, and which would be more pliable than leather. But the utility of these articles seems to vanish when the expence attending such processes is considered.

Many chemists, however, have since that time repeated Macquer's experiments, but without success. Among this number is Berniard, who found means to charge with caoutchouc oil of lavender as well as oil of turpentine, and to dissolve it in oil of camphor and in expressed oils.

I repeated Macquer's experiments with more success, by suffering the caoutchouc to digest in ether for twenty-four hours, and then keeping the matrass in the heat of a balneum mariæ to evaporate the most subtile part of the ether. The solution of the caoutchouc did not take place till the ether had decreased nearly one half in volume.

One of the cases to which the great elasticity of this substance may be applied with the best success, is to afford relief in diseases of the bladder which require the use of a catheter. The fabrication of hollow elastic catheters seems to be one of the most striking and best contrived objects of the discovery of caoutchouc, considered under the view of its utility to society.

Draftsmen employ it to wipe out stains from paper, false strokes, and outlines done with a black-lead pencil.

Caoutchouc was employed in the composition of the varnish with which the first balloon launched at Paris was covered. The constructors of it endeavoured to unite strength with a certain degree of pliableness, conditions which appear to be essentially neccessary in such machines; but this varnish is very long in drying.

ISINGLASS, FISH GLUE.

Isinglass, fish glue, or ichthyocolla, is extracted from the air-bladder of a large fish (sturgeon), which emigrates from the Black sea into the Danube, and which is very abundant in that river from autumn to the month of January. During the fishing season the fishermen employ themselves in the preparation of this substance on a large scale. They first take out these bladders, and, having opened them, remove, by means of weak lime water, all the viscid matter which adheres to them. They separate from them also the fine membrane by which they are covered, and then expose them to the air to make them experience a commencement of desiccation; after which they roll around each of them the membrane separated from it, in order to convert it into a kind of cord of the size of the finger. This cord is twisted into the form of a heart with obtuse angles; the two ends are brought together, and fastened in that manner by a small wooden peg, which prevents the separation of the laminæ during the rest of the desiccation. These rolls are hung up in the open air to dry. They have the shape of small handles, and are brought to us under this form.

When it is necessary to extract the glue, these rolls are bruised; and, being torn into small portions, are boiled with a sufficient quantity of water. The membranaceous part, which remains insoluble, soon gives up its gelatin, or glue, which is separated by straining it through a piece of linen; and in this state it forms, at most, a 25th part of the whole matter employed for the decoction.

Fish gelatin (fish glue) is much used for giving a lustre and stiffness to ribbons and gauzes. It is a kind of varnish; it is the basis of the English court plaster, the preparation of which is terminated by the application of a coating of balsam of Peru.

In the art of varnishing, it is employed for defending cut-paper works, &c. from the attacks of the varnish applied to them. Without this precaution the varnish would be imbibed, and form spots.

This gelatin, when baked with a little sugar, constitutes lip-glue. It is employed, on account of its viscosity, for clarifying coffee and purifying wines: for the latter purpose, however, *albumen* or *white of egg* is preferable, because it is not attended with the fault of incorporating with the wine, and of remaining in it in a state of solution.

COPAL.

Copal is a resinous substance which distils naturally from a large tree abundant in New Spain. Copal is produced also in the East Indies; but in that country it is rarer. It passes gradually from the consistence of oil to the state of solid resin. The insects, such as flies and ants, inclosed in it sufficiently prove that this matter has been liquid; and that it is indebted for its solidity to two causes united: the contact of the air, which dissipates its volatile principles, and the action of the solar rays.

Copal, such as exhibited to us in commerce, emits a strong odour when burnt. It is hard, solid, and transparent; has a shining surface of a faint lemon colour, but sometimes inclining to orange.

Of all those who, through taste or by profession, have employed themselves in the preparation of varnish, no one seems to have observed a very remarkable character of copal, which is, that it forms an intermediate line between the common resins and amber, in regard to their property of dissolving in spirituous liquors. Like amber, then, it exhibits a particular substance. It resembles those resins most commonly employed in varnishes, by suffering itself, under certain circumstances, to be attacked by oily substances which exercise no action on amber; and it approaches the latter by the resistance it opposes to the action of spirituous liquors, which readily lay hold of all the real resins.

When destined for the composition of varnish it ought to be chosen pure. I have remarked that the copal which exhibits a very ambery colour opposes less resistance to solution than the purest and consequently the least coloured copal: the cause of this will be explained hereafter.

It was first known under the name of gum copal; but the phænomena it exhibits in the fire, and the resistance it opposes to the action of water, have induced naturalists to distinguish it by the appellation of copal resin. This name, however, is as improper as the former, because alcohol (spirit of wine) does not exercise its action on copal with the same energy as it does on resins. These distinctions, which are more or less correct, show the necessity of admitting the specific name of copal, laying aside any expression that might tend to define its particular nature. The principal chemical properties of copal are as follow:

1st. Copal is in part soluble in alcohol, when directly applied; that is to say, without any intermediate substance.

2d. It is wholly soluble in alcohol, when, being very much divided, it is first subjected to the action of a fluid less aqueous than alcohol, and which becomes a medium that facilitates its union with it. This effect is obtained by beginning the solution in essence of lavender.

3d. It is wholly soluble in essence of turpentine, and without any intermediate substance, after the latter has acquired from the solar light a state of density and a particular modification, which establish in it a sort of homogeneity with the principles of the copal; or when the copal has undergone a particular modification from heat.

4th. It is wholly soluble in sulphuric ether, and without any intermediate substance, when that liquor is proved by its specific gravity to be in a state of great purity; for it must not be imagined that every fluid called ether is proper for the particular case to which I here allude.

It is then certain that alcohol cannot be considered as a vehicle proper for the solution of copal. The author of The Complete Varnisher does not appear to be of the same opinion, since he introduces copal into several recipes for varnish composed with alcohol. I have, however, ascertained one fact, which proves that the addition of copal to certain resins contributes to the durability and even to the splendour and brilliancy of the varnish; but when this mixture is used the copal ought to be ground in small quantities on a piece of porphyry, with strong doses of resins readily soluble in alcohol.

GUM ADRAGANTH, OR TRAGACANTH.

This gum distils spontaneously, or by incisions, from a small shrub named *tragacantha*, which is very abundant in the Levant, and particularly in the island of Candia. The gummy sap hardens into long filaments, or small ribbons, twisted in the form of worms. This gum, of a colour more or less white, is dry, inodorous, and has a sweetish insipid taste; a character which belongs to all gummy juices.

It ought to be chosen pure, white, and transparent: that which is yellow, black, or mixed with foreign bodies, must be rejected.

When put to soak in water it swells up a great deal, and assumes the consistence of very thick mucilage. This mucilage is sometimes employed by miniature painters, when they are desirous of rendering the vellum on which they paint as smooth as a plate of ivory. For this purpose, they put the mucilage into a piece of fine linen, tie it into a knot, and rub it over the vellum.

In painting in distemper a solution of gum tragacanth is substituted for aqueous solution of gum arabic, in mixing up colours of a saline nature. This mucilage, at least, is used with that beautiful liquid blue which admits into its composition concentrated muriatic acid (marine acid*). This mucilage has more body than that of gum arabic.

GUM ARABIC.

This gum distils naturally from the fissures in the bark, and from incisions made in the trunk of the *real Egyptian acacia*, which abounds in Egypt, in Arabia, Senegal, and several places on the coast of Africa. This gummy juice is found in pieces of different sizes, sometimes round, sometimes angular, and sometimes folded double. They are of a yellowish-white colour, brittle and brilliant. They communicate to water in which they are dissolved a glutinous viscosity, and give it an insipid taste, but unaccompanied with any smell.

This gum often exhibits a dark amber yellow colour: it is found even sometimes reddish, and in globular fragments. The latter kind is more particularly known under the name of Senegal gum. The mucilage it produces is more viscid, and dries with difficulty. The surface of preparations made with this gum often dries rapidly by the contact of the air, while the interior part assumes a softer consistence than it had before. In general, the mucilage resulting from Senegal gum has not the same softness as that of gum arabic: dry white gum arabic then is, in all cases, preferable.

When it is necessary to employ gum arabic in mixing up colours, or to form a coating for the purpose

* See this composition in the Second Part.

of preventing varnish from penetrating those articles to which it is applied, it will be proper to select pieces which have the least colour; which are driest, most friable, and in particular free from any mixture of straw, bark, &c.

Mucilage of gum arabic is never so thick as that produced by gum tragacanth. When the gum is good and well chosen, it is colourless, and as transparent as water. This mucilage, when a little diluted with water, forms one of those matters which ought to constitute the first class of varnishes, as we shall show in treating on the division of its compositions. It performs, indeed, in a certain degree, the office of a varnish when water colours are employed; but the apparently vitreous coating which it forms is subject to the impressions of moisture. It is however used for covering delicate articles intended to be varnished, such as cut paper work, &c. This mucilage preserves the ground and the colours from being attacked by the varnish.

GUM LAC, SEED LAC.

This substance, called improperly a gum, is the result of the industry of a kind of winged and flying ants found in several parts of India, such as Bengal, the kingdoms of Pegu and Siam, &c.

These ants deposit the resin on the branches of a kind of jujube, or on reeds and twigs, which the inhabitants take care to plant in the earth, in order that they may turn to advantage the industry of these insects.

If the reddish and tuberous covering with which these ants surround certain parts of a twig be carefully examined, it will be found that each tubercle contains small cells, or alveoli, nearly similar to those in a honey-comb. They cover their cells on the outside with a thicker coating than that in the inside, in order to defend from the rain the young generation contained in them. This substance, the resinous nature of which is proper for accomplishing the latter object, is of a dark red or lateritious colour, and is of a tolerable consistence.

Each cell contains a small round, and as it were moulded, body. This body is of a beautiful red colour, and when bruised gives a powder as red as cochineal.

These small bodies, which, no doubt, are the embryos of the insect, communicate their colouring part to water, and to resinous or oily substances. It is this matter which gives to gum lac its peculiar colour.

Lac is known in three states. Lac in sticks is that still attached to the extremities of the small twigs on which it has been deposited; seed lac is the same after it has been separated from these twigs; and shell lac is also the same which has been melted and cast into thin laminæ.

Lac is not a pure resin: it does not dissolve entirely in alcohol (spirit of wine). There remains an insoluble matter, which seems to participate in the nature of wax.

Seed lac gives a tough strong varnish, which is employed for musical instruments, such as violins, basses, &c. For this purpose, it may be used in the state in which it comes from the shops, that is to say, in grains; but in this state it is deprived of its colouring parts, which the Indians apply to their printed cottons, so much sought after in Europe on account of the fixity and brightness of their colours. The want of this colouring part may be supplied by an infusion of anatto, which increases the beauty of the varnish destined for musical instruments.

SHELL LAC.

Shell lac is prepared with that separated from the twigs to which it adheres. It is washed in water to carry off the colouring part; it is then melted, and poured on a marble table, over which it is spread out to be formed into thin laminæ: these laminæ are then distinguished by the name of shell lac.

Under this form it becomes one of the principal ingredients of sealing wax, which is coloured with vermilion to form red wax, or with lamp black to form black. This sealing wax is also made to have a shining and speckled appearance by mixing the shell lac with small scales of mica or aventurine, or with laminæ of orpiment; but the latter mixture is noxious, and emits a bad smell.

MASTIC.

Mastic is a resin; by which expression is understood a friable inflammable substance, more or less odorous, soluble in whole or in part in alcohol (spirit of wine), and insoluble in water. Such are the chemical characters by which we are enabled to distinguish substances whose external appearance is sometimes nearly the same, though they are very different in regard to their component principles.

Mastic is sold in small grains or transparent tears of a lemon colour. It distils by incision, or even without incision, from the bark of the lentiscus, a tree very abundant in the Levant. This resin readily melts over the fire; it has a sweet and slightly aromatic smell, with a weak balsamic savour.

The purest mastic is found in the island of Chio: but it is reserved for the use of the Turkish ladies, who chew it, as it has the property of cleaning the teeth, strengthening the gums, and rendering the breath sweet.

The distinction of male and female mastic is void of foundation. That intended for varnish ought to possess all the characters already mentioned. The mastic brought to us by the way of Marseilles is not always pure: it is a mixture of beautiful tears with grains dirtied and adulterated by fragments of the bark of the lentiscus. Varnish compositions admit only the purest mastic, as little coloured and as transparent as possible. Mastic is often confounded with gum sandarac: the former, however, may be easily known, as it is always in round tears of a greenish white colour, while those of sandarac are long, a little more coloured, and somewhat yellow. Besides, all uncertainty may be removed by two very simple tests. Mastic readily dissolves in alcohol, which exercises a weaker action on sandarac. Mastication, for which this substance is reserved in the Levant, affords a second means of distinguishing these two resins: mastic under the teeth becomes pliable, and may be drawn out in the form of a cord, like turpentine boiled in water; but sandarac separates into small grains, and has a bitter taste, which is not found in mastic.

This resin gives toughness to varnish, and sufficient hardness to bear polishing. Compositions in which it does not enter are incapable of enduring that operation.

GUM ANIMA.

There are two kinds of this resin: one found in the East, which was formerly brought from Ethiopia; and that of the West, which comes in particular from Brazil. The former has a sweeter odour than the other, which is more common in commerce.

The best pieces are of a pretty large size: they appear marbled with white, opake and yellow transparent veins. This substance has a sweet and agreeable smell. Externally it often exhibits the same appearance as copal; but it is more brittle, less solid, and melts more readily over the fire, or while burning emits a bright flame.

The tree which produces this resinous substance is known in America under the name of *courtaril*. It is found also in Africa.

Its use in the composition of varnish is very limited. It forms part of the least drying alcoholic varnishes. When treated alone with that liquor it does not unite into a mass, even though subjected to a balneum mariæ; and it always remains in a pulverulent state. This residuum, however, which continues insoluble when there is no mixture, dissolves in part in alcohol when mixed with other resins that are soluble. It communicates to varnish an agreeable odour, which renders it proper for being employed on articles belonging to the toilette. It ought to be chosen new, and exceedingly pure; which may be known by the extent of the transparent parts.

GUM ELEMI.

There are two sorts of gum elemi; one of which comes from Ethiopia, and the other from America.

That of Ethiopia is the real kind. It is brought to us by the way of Marseilles in small cylindric fragments, seven or eight inches in length, and nearly two pounds in weight. It emits a very agreeable odour of fennel: it is almost entirely soluble in alcohol (spirit of wine). It has a greenish colour, and is interspersed with some reddish veins or glands. It has a solid consistence, and yet is susceptible of becoming soft under the fingers. This sort is enveloped in the leaves of the palm tree, or of that kind of reed called the Indian cane. It is believed that this resin distils from a species of middle-sized wild olive tree.

The gum elemi imported from Brasil and New Spain is far from exhibiting the same characters. It is brought to Europe in large, soft, glutinous masses, and becomes solid only in the course of time. It is yellowish, semi-transparent, and has a resemblance to gallipot or white incense. Its smell seems to give reason for suspecting that the latter substance is mixed with it.

It is believed that the tree which produces it is a kind of balsam tree, and that it grows to the height of the beech. In regard to this point naturalists are still divided in their opinions. But whatever may be the origin of gum elemi, it is not proper, unless pure, for being introduced into the composition of varnish. The elemi of Ethiopia ought therefore to be preferred to that of America, both on account of its consistence, which is better suited to this composition, and of the sweet smell which it communicates to varnished articles. Besides, it gives to the composition a toughness and durability, which it would be in vain to expect from that of America.

GUM GUTTÆ, GAMBOGE.

This substance forms one of the resinous gums; but, as the resinous part predominates, it perhaps may not be improper to distinguish it by the name of resin. It is the dried product of a milky juice, extracted by incision from the bark, the trunk, and the uncovered roots of a large tree, the species of which has multiplied very much in the country of Gamboge, in part of the kingdom of Siam, and in China. The inhabitants of the country, according to the relation of travellers, give to this tree the name of *carcapulli*.

This resin, in the state of desiccation in which it is imported, is dry, solid and compact, hard, opake and inflammable, and of a yellow colour inclining a little to red. Such are its physical qualities. A greater quantity of it is taken up by alcohol (spirit of wine) than by water. In both these fluids the insoluble part is precipitated: these are its principal chemical characters:

It gives a very beautiful yellow colour, which renders it exceedingly proper for water colours. In this respect it is used for washing and for miniatures. It possesses a colouring principle, much sought after for giving a gold colour to the compositions of changing varnishes. It communicates to them also body and brilliancy.

This substance is not susceptible of much choice. It ought to be smooth and brilliant on the fracture. It has a kind of vitreous appearance. It may be proper here to observe that it is a violent purgative, and that a very small dose of it is capable of producing the most irritating effects. This observation is addressed to painters who have the bad practice of wiping their brushes with their mouth.

SANDARAC, GUM SANDARAC.

Gum sandarac is extracted from a large kind of juniper, which grows in warm countries, such as Italy, Spain, and in particular Africa. It distils from the tree naturally, or from incisions made in the trunk during the hot weather. It exhibits itself under the form of tears, sometimes elongated, sometimes round, and sometimes folded together. That most esteemed is in bright, shining, and transparent tears of a pale yellow colour. It has a balsamic odour, and its taste is somewhat acrid.

It is called also *vernix*, because it was the first substance employed by the antients in the composition of varnish, to which it gives solidity.

As a resin, it is soluble in alcohol, in essential and fixed oils*, but less so than mastic. By this union, and particularly by that with alcohol and essence of

* However, when it is necessary to unite it to drying oils, the same process must be employed as that used for the preparation of amber and copal varnish.

turpentine, it forms a varnish which possesses great splendour; but it is soft, and is easily scratched by the least friction. The varnish, however, may be rendered harder by mixing the sandarac with other resinous substances, not so dry, such as gum elemi and gum anima. It is one of the principal bases of alcoholic varnishes.

If this resin, when in the pulverulent state, be rubbed over scratched paper, it restores the surface. The paper may then be written upon without the ink sinking.

Though the exterior or physical characters of sandarac may be easily distinguished, there are numerous examples of other substances being fraudulently substituted in its stead, to the great prejudice of the artists who employ it, and who apply, in confidence, to fragments of copal, processes proper only for sandarac. I have often been consulted on similar occasions respecting the inactivity of alcohol applied to supposed sandarac. Artists, therefore, before they purchase large quantities of what is usually sold in the shops under the name of this substance, ought to try a small portion of it, by which means they may save both time and money; for it is not possible to trace back these adulterations to their source, in order to be indemnified.

DRAGON'S BLOOD.

Dragon's blood is a dry, friable, inflammable resin, of a dark red and almost brown colour on the outside. When in large thin laminæ it is transparent. It has neither savour nor smell when cold; but when burnt it emits a balsamic odour.

This resin is produced by a tree very common in the Canaries, in Jamaica, and in the East Indies. This tree, called the dragon tree, rises to a considerable height: its trunk is smooth, like that of the palm tree.

There are several kinds of dragon's blood. That most esteemed comes to us in small masses of the size of an olive, wrapped up in the leaves of a species of reed. Some enveloped in this manner is brought from India: no difference is observed but in the globular form given to it. In general, the dragon's blood sold under the globular form, or that of an olive, is of the finest quality.

Another kind is of a soft consistence, and requires some time to become solid. This sort is also of a good quality, but inferior to the former.

There is even a third kind known in commerce, which is sold in the form of round cakes. It is of a dull red or brick colour; and appears to be a compound of different resins coloured by brickdust, or by Brasil wood, or with a portion of real dragon's blood. In the fire it does not inflame, but swells up. This kind is absolutely improper for the composition of varnish.

Real dragon's blood readily unites with alcohol and with essential and drying oils: it is, however, employed only for alcoholic varnishes, or those made with essences, and particularly in the case when it is required to make a changing varnish destined for foil or tinsel, or for gilt leather.

AMBER, KARABÉ, YELLOW AMBER.

Amber, generally known under the name of *yellow amber* and *karabé*, is one of those substances on which a great deal has been written. It has been an object of the combined researches of mineralogists and chemists. The results of the chemical analysis of it were well calculated to excite their curiosity, and to induce them to continue their experiments. The physical and chemical properties of amber, so different from those of other resinous substances, and the places where it was found, indicated, in some measure, its real origin, and inclined them to consider it as a particular substance.

It does not, indeed, appear to have a direct affinity to any of the pure resins. Copal, though essentially different, seems to be the only substance that approaches nearest to the nature of amber, which has nothing in common with resinous substances but the property of being very inflammable. These were sufficient motives to induce naturalists to attempt to discover its origin; but notwithstanding the numerous researches made on that subject, there are few substances respecting which so much uncertainty prevails. Laying aside, therefore, all conjectures which have appeared probable to the different persons who have applied to this research, we shall confine ourselves to those facts best established, and most capable of giving us certain ideas in regard to its nature.

Some philosophers believed, with Philemon, that amber originated from the earth, and did not depend on any particular organization. Some of our philosophers, at present, have revived this idea in regard to the origin of bitumen. Pliny the naturalist adopted the opinion of the Greeks, by assigning to amber a vegetable origin. He considered it as the resin of the pine tree hardened by the autumnal cold. In these remote ages, comparative analyses, being unknown, could not contribute to rectify this idea.

This instability of opinions required direct observations, or the concurrence of various circumstances; which fortunately took place under the reign of Frederic William, king of Prussia.

Ducal Prussia, of all the countries with which we are acquainted, is that which seems to be most favoured by nature in regard to mines of amber. This production afforded considerable exercise to the national industry under the reign of that prince, as a strong taste prevailed at that time for ornaments and trinkets made of amber. At that period the resources of chemical analysis were sufficiently certain to inspire confidence in regard to the result of them. The study of natural history, the success of which seemed to depend on that of chemistry, acquired then a consistence which gave the best hopes of its future advancement. Such was the state of circumstances which seemed most favourable for fixing the opinion of naturalists in regard to the nature of amber.

Hoffman, a celebrated chemist, required only the invitation of that prince to employ himself in researches, which he had the better opportunity of bringing to a fortunate conclusion, as he was in the centre of a country where this substance abounds, and is dug up from a mine. It was of importance to examine the soil, which exhibits different strata; but Hoffman does not mention their thickness. The first is of sand; the second of clay, fifteen or sixteen feet in thickness; and the third is composed of trees impregnated with sulphurets of iron (martial pyrites), bituminous, and as it were burnt. These trees have no consistence: some of them are of a large diameter, and in a state of pretty good preservation. This stratum of mineralized wood is not of equal thickness: some travellers make it to be forty or fifty feet.

Under this collection of bituminous wood is found a stratum of sulphurets and of sulphate of iron (pyrites of iron, and vitriol of iron, or green copperas); and it is not uncommon to meet with pieces of amber still adhering to the lower part of the trunks of the trees. They appear there under the form of stalactites.

This stratum of sulphurets and sulphate of iron rests on a bed of coarse sand. This sand is the reservoir of the amber, which is often found there in scattered fragments, but sometimes also in large masses. Under this bank of sand the argillaceous bank commences, and prevents the amber from penetrating further.

The large fragments of amber have always a pyramidal form, which attests its distillation from the trees above, and removes every doubt in regard to its vegetable origin. The most conclusive argument, however, is that deduced from the pieces of amber which partly penetrate into the sand, and still adhere by their upper extremity to the maternal stock.

This substance, being at first liquid, carried with it and enveloped different insects adhering to the bark of the tree, and, together with the vegetable mass, must have been buried by the effect of one of those grand revolutions to which our earth has been subjected. With the period of these revolutions we are unacquainted, but evident traces of them are still every where visible.

Bernard de Jussieu, the object of whose ruling passion was the sciences, and who applied to them with as much success as ardour, has remarked that the insects inclosed in amber do not belong to our continent. The schistous impressions found in our soil and in the neighbourhood of Toningen confirm this opinion, by the kind of plants the type of which they represent.

As the observations of Hoffman have been fully confirmed by Neuman and later philosophers, a vegetable origin may be assigned to amber. It is probable that the impression of mineral waters, and the action of different gases developed by the intestine fermentation, which must take place in the mass of these buried vegetables, are the causes of the principal differences observed between amber and resins, which have not been exposed to the same circumstances.

However, when it is considered that copal in a certain degree participates in some of its properties, one might almost be induced to believe that the tree which produces amber is the same as that which furnishes copal, and which grows only in the torrid zone*.

* If it be considered, on the other hand, that amber, besides the characters which distinguish it from other resins, possesses a property which seems to give it an affinity to certain resins or balsams

Amber exhibits itself under various appearances. It is found white and opake, sometimes exceedingly transparent, and of a pale yellow colour; at other times of a beautiful dark golden colour. It is described as a bituminous substance, dry, brittle, and inflammable. It is hard, and susceptible of a fine polish: it is easily worked in the lathe, and is then highly brilliant, and forms beautiful trinkets.

When rubbed on a soft body, or piece of cloth, it exhibits an electric property, on which account it was called by the antients *electrum*. Its other name, *karabé*, is originally Persian: it signifies the *attractor of straws*, an effect arising from its electric virtue.

Its specific gravity is very little superior to that of pure water. If the water be mixed with a saline body, or only slightly charged with sulphate of lime (selenite), as unboiled water often is, or if it be very near the term of congelation, it becomes equiponderable to amber. It is, no doubt, owing to one of these circumstances that we are indebted for the discovery of pieces of amber carried away by the rolling of the waves of the Baltic, which detach them from the deep mines where they are uncovered, and convey them to the shores.

If amber be only rubbed, it has no smell; but if exposed to a strong heat, it emits an odour far from being

that furnish a volatile essential salt, have we not as much reason to think that the amber-tree belongs to the family of the *badamiers*, some of which are tall, and furnish benjamin? or to those large trees which give by incision balsam of Peru, a substance which, as is well known, furnishes an acid and volatile essential salt?

disagreeable: when melted over the fire it is in part decomposed, and exhales a strong, disagreeable, bituminous smell.

Some chemists and certain artists, it is said, have found means to communicate to amber ductility and permanent elasticity, as well as different colours, and to make it serve as a covering to various reptiles, without altering its nature, as a forced liquefaction would do. It is even said that certain miners have been able to render opake amber transparent, by subjecting it to chemical processes. All this may be true; but it appears certain that the pretended elastic amber was not so.

By the addition of camphor to copal I obtained a small, flexible, elastic mass, which has retained its ductility already six months*. Would the case be the same with amber? All the attempts hitherto made to modify its nature have had no other object than that of enhancing the price of it. No discovery the sole object of which is avarice, exhibits motives sufficiently noble to induce the philosopher to employ himself in researches respecting it.

The amber mines are not confined to Ducal Prussia, or to the Baltic sea, which washes its shores. It is found in many other countries, such as the march of Ancona, Sicily, Saxony, Poland, and Sweden. It is met with in several cantons of France; but Prussia has the noble privilege of presenting it in large masses, and sufficiently pure to form a very lucrative object to the national industry.

* I shall enlarge further on this subject in the article on copal varnish.

Amber formed into trinkets and various female ornaments maintained formerly a very important branch of commerce, the ramifications of which extended to every part of Europe and to Asia. The use of precious stones, which acquired a preference in consequence of their brilliancy, has very much abridged the advantages of this commerce, which is now confined to Persia, India, and China.

The art of varnishing, however, has opened to it another channel of consumption in Europe. It forms the base of those beautiful varnishes, the splendour and durability of which have so much contributed to extend the reputation of the celebrated Martin.

Amber does not unite indiscriminately with all spirituous liquors, or with all the different oils usually employed in the composition of varnishes. It would even resist fat drying oils, if the preliminary preparations which convert it into varnish were neglected.

Essential oils exercise very little action on amber; and this is the case even with essential oil of lavender, which some authors suppose in this case to be sufficiently powerful.

Ether, according to experiments which I made, effected a sort of division of this substance. It swelled up as cork does when placed on burning coals, and became pulverulent. But, notwithstanding this tumescence, which announces a division of parts, there was no solution. By evaporating the ether the amber resumes its original form and consistence.

Alcohol (spirit of wine) distilled in a balneum mariæ over amber detaches a portion of it, which constitutes essence or tincture of amber, an article very much used in medicine. When the first portions of the alcohol distilled are re-distilled several times over the powder contained in the balneum mariæ, the tincture is sufficiently charged to form a kind of varnish; especially if a fourth part of the vehicle be separated from the filtered tincture by a new distillation: but to succeed in this experiment the alcohol must be very pure*.

This fact will appear directly contrary to the theory of Watin, explained at full length in his critical notes on a work entitled *Le Parfait Vernisseur*. "If amber," says he, "were kept a hundred years in a balneum mariæ under spirit of wine, it would always remain the same."

After the numerous and continued experiments of this kind which I made on amber, both in consequence of my situation, and with a view of rendering my researches applicable to the art of varnishing, I should not have hesitated to advise the union of amber with the different resins employed in the composition of varnish, when it is intended to give them more body, had I not found in copal a substance somewhat more tractable than amber, and which possesses in the same degree the qualities sought for in the latter †.

* I have no doubt of the complete solution of amber in tartarized alcohol, as practised by Hoffman; but this method, which might be useful for certain medical purposes, cannot be employed in the composition of varnish of this kind. In this process the alcohol and the amber experience alterations which deprive them of the qualities essential to the nature of varnish.

† See the first kind of varnish, No. 2, Part I.

Amber destined for the composition of varnish must be chosen pure, transparent, and without any mixture of foreign bodies, which render it valuable only to the collectors of natural curiosities.

TURPENTINE.

Four kinds of resinous juice are denoted by the name turpentine*, though this denomination seems properly to belong only to the resinous fluid which distils from a tree called the turpentine tree, and from which it takes its name.

Under this denomination indeed are comprehended, 1st, The turpentine of Chio, which on account of its balsamic qualities is preferred to every other kind, and particularly in medicine. 2d, Venice turpentine. 3d, That of Strasburgh, or the German turpentine. 4th, The coarse or common turpentine, brought from the southern parts of France.

These kinds of turpentine have physical qualities common to them all; but it is observed that they are variously modified, and produce differences which give reason to believe that they are not all proper for the same uses.

Turpentine has a consistence more or less fluid. It is viscid and tenacious; has a strong aromatic smell in

* In treating of turpentine I shall take a general view of all the substances of which it forms the basis, such as pitch, resin, tar, &c. I shall follow the order prescribed by the operations to which it is subjected, as the best method of giving a detailed and connected history of this substance, which is singularly modified both by nature and by particular processes.

different degrees, and a bitter taste more or less acrid. It is produced by different resinous trees, which exhibit to the researches of the naturalist differences in their particular organization more remarkable than the chemist finds in the resinous juice which is obtained from them.

In many cases this substance is prepared by nature alone; but for the most part her efforts are assisted by long incisions made in the bark of the trees, and which penetrate even to the soft part of the wood. The viscous juice, which flows from these incisions, is conveyed into vessels placed at the bottom of the tree, by means of pieces of bark bent into the form of a gutter. The product is immediately removed, to prevent its being exposed to the influence of the air, which would occasion a change in its consistence. Time, and the different changes produced in this juice by art, seem to extend or vary the degree of its utility, as applied to medicine, to the purposes of navigation, and to the arts.

When this liquid product is left to nature, the air and the sun exercise on it a speedy action. The volatile oily principle is dissipated, and nothing remains but a tenacious glutinous matter, which at first is called *barras*, and which is sold in the shops under the name of *gallipot* or *white incense*. It is distinguished from marbled incense by being cleaner and not so dry. But in whatever state exhibited, either by nature or by art, industry finds means to vary its properties by applying it to different uses.

TURPENTINE OF CHIO.

Turpentine of Chio, extracted by incision, or without incision, from a tree known under the name of the turpentine tree, has a firmer consistence than the other kinds of turpentine: but in this respect it varies. Sometimes it has the hardness of honey; is viscid and flexible; and in this state is transparent. At other times it is friable, and breaks between the fingers into small fragments: its colour is then blueish-white, or inclining to green. It has a strong balsamic odour; its taste is acrid and bitter. This kind of turpentine is the rarest and most esteemed. It may be employed in small quantities in the least drying kinds of varnish, that is to say, in those which admit the union of gum elemi, gum anima, &c.

VENICE TURPENTINE.

The turpentine of Chio, just mentioned, was long known under the name of Venice turpentine, because the Venetians, who got into their hands a great part of the Levant trade, sent to every part of Europe all the productions of these countries. At present, that distinguished by the name of Venice turpentine is produced by a kind of larch tree very abundant in the Apennines, in part of the Alps of the Grisons, of Savoy, and even of the ci-devant Grenoble. It is fluid, limpid, glutinous, tenacious, and of a consistence between that of oil and that of honey. It has a yellowish-white colour, and a strong penetrating yet agreeable smell, inclining somewhat to that of oranges. It possesses a more acrid and a bitterer taste than the turpentine of Chio. This second kind is fit for the composition of varnish.

TURPENTINE OF STRASBURGH.

The turpentine of Alsace, or of Strasburgh, is produced by a kind of silver fir, with leaves like those of the yew tree. When fresh it is liquid, and more transparent than that of Venice, but less viscid and tenacious. Its smell is very agreeable, and has more resemblance to that of oranges than the smell of the Venice turpentine. It has nearly the same taste as that of Chio.

This turpentine, like that of Venice, takes its name from the city which carries on with it the greatest trade. It is extracted from the firs which grow in great abundance in the northern parts of Germany, in Switzerland, the ci-devant Lorraine, &c. There are formed on the bark of these trees vesicles filled with this resinous juice, which the peasants collect by means of a cornet of tin plate terminating in a very sharp point. This instrument serves for piercing the vesicles, and for receiving the juice which flows from them.

This turpentine also is exceedingly proper for varnish; but it gives less body to the composition than that of the larch. In general, the addition of turpentine to varnish contributes to give it a great deal of splendour, but does not render it more durable.

COMMON TURPENTINE.

The fourth kind of turpentine is reserved for less valuable purposes, and ought not to be employed in the composition of varnish. It is produced from the wild pine, and may be obtained either by or without incisions. It has a viscous consistence, is white, almost opake, and more tenacious than those of Venice and Strasburgh. It has a stronger smell than the other kinds of turpentine, and its taste is acrid, bitter, disagreeable and nauseous. It is a production of the southern departments of France, where these pines are found in great abundance. It is called *coarse turpentine* and *bijon*. This turpentine, when it has acquired consistence by exposure to the air, forms what is called gallipot.

All the resinous trees above mentioned, of whatever species, are a source of wealth to human industry, which knows how to vary the employment of them. On account of their great height, their lightness, and their pliability, they are exceedingly useful for ship-building. Their product, after it has experienced certain modifications, distinguished by particular names, furnishes different substances which are highly useful in navigation, in medicine, and in the arts. The same substance, indeed, gives essence of turpentine, ethereous essence of turpentine, colophonium, white incense, resin, white or Burgundy pitch, tar or liquid pitch, oil of cade, dry black pitch, naval pitch, and lamp black.

These substances, the exterior characters of which seem to be so different, and which indeed are applied to purposes which admit of no comparison, have all the same origin. They are all produced from turpentine, such as it is formed by nature, or modified by the air, or by the action of chemical processes; and they all concur towards the composition of varnish, more or less valuable or useful. This consideration alone renders it necessary to give a short description of each, in order that their nature and properties may be better known.

ESSENTIAL OIL OF TURPENTINE. ESSENCE OF TURPENTINE.

Turpentine extracted from the vesicles of the silver fir, after being mixed with a great deal of water and subjected to common distillation, gives for result a light and highly volatile oil, which is sold in the shops under the name of essence of turpentine. In Switzerland this oil is prepared from the cones of the silver fir, which are collected for that purpose in the month of June, a season when they are filled with liquid turpentine. They are cut into slices, and distilled with water in large alembics. The oil is separated from the water, which passes over at the same time, by means of large glass funnels.

This oil is light, colourless, of a penetrating smell, and has a singular influence on our organs; for if a person only touch it, or inspire air impregnated with its effluvia, the urine acquires a strong smell of violets.

By distillation with water this essence is always exceedingly clear, limpid, and colourless: when distilled without water, even in a strong heat, it is less fluid, and assumes a lemon colour: it is also more oily and fatter.

COLOPHONIUM.

When turpentine is distilled with water, the solid resinous part, which cannot be volatilized, remains confounded with the water of the bath, and constitutes what is known in the apothecaries' shops under the name of baked turpentine. It is separated from the water, and, being left to drain, is again melted before it is made an article of commerce, in which it is known by the names of colophonium, *arcancon*, *brai sec*, *poix Grecque*.

If the distillation has been effected without water, the colophonium is of a darker colour; it is red, and often reddish-brown.

This colophonium is very much used, under the name of *arcancon*, in the composition of certain kinds of varnish. For this purpose, that which is most transparent and least coloured ought to be chosen.

WHITE INCENSE. GALLIPOT. BARRAS.

These different denominations express rather the state of purity and consistence of the resinous substance furnished by the pine and the silver fir than any essential difference in its nature.

The name *barras* expresses the soft resin which adheres to the bark of the tree, and which often contains fragments of it, as well as dust and sand conveyed to it by the wind. It is sometimes seen resinified by the action of the air and of the sun.

The word *gallipot* denotes the same substance, but in a state of purity, in consequence of the care taken when it distils to convey it into wooden troughs placed at the bottom of the trees, or into pits lined with fat earth. This matter is viscous.

What is called *white incense* is gallipot resinified, and become friable by long exposure to the air.

PINE RESIN. RESIN.

A mixture of white incense and barras, exposed to a heat capable of rendering these substances liquid, without experiencing any alteration, and poured upon a kind of mats covered with straw, constitutes, after it has cooled, what is sold in the shops under the name of resin.

ANOTHER METHOD OF PREPARING RESIN.

The inhabitants of the mountains of Switzerland are acquainted with another process for the preparation of this substance. They collect under sheds the old trunks of resinous trees, with which they surround a sort of hearth, and kindle a large fire on it. The heat, by penetrating these trees, melts the resin, which distils slowly into troughs fixed at the extremity of the trunks, and the flowing of the liquid is facilitated by the oblique position given to the trees. They then place over a fire all the different products, and form them into cakes, which they sell in the neighbouring villages. The trunks from which the resin has been extracted are then split into fire-wood, and serve them for fuel in the winter.

This resin is purer than that produced by a mixture of white incense and barras; and is preferable, when the fire has not exercised on it too immediate an action.

White incense and resin are employed in the composition of the common varnish with which dark colours are mixed.

BURGUNDY PITCH. WHITE PITCH.

Turpentine extracted from the turpentine tree, from the larch and the silver fir, is exceedingly pure; but that obtained from the pine and from the spruce fir, *picea* or *epicea*, is impure, as well as less fluid, less balsamic, and less transparent. The Burgundy pitch sold in the shops is either natural or adulterated.

A simple mixture of gallipot and barras, made without heat, is often sold under the name of Burgundy pitch; but the mass resulting from this combination soon becomes friable. It has neither the unctuosity, nor the viscidity, tenacity, or smell which constitute real white pitch.

The *picea* or *epicea*, spruce-fir tree, which produces the latter, does not contain the resinous juice disseminated through particular reservoirs, as it is in the spruce fir, nor under the bark, as in the pine. A white resinous and pretty thick substance exudes from the bark, and is collected by the peasants in summer. They melt it, and, having strained it through a cloth, put it into barrels. The real Burgundy pitch is prepared in this manner.

When the resinous juice is collected too late, and has become rather too thick, they lessen its consistence by mixing with it, over the fire, a little turpentine and oil of turpentine. This substance is employed only for those common kinds of varnish applied to ships and boats.

BLACK SOLID PITCH.

Burgundy pitch melted, and mixed, at the time of its liquefaction, with lamp black, constitutes a black semi-friable substance, susceptible of melting at a common temperature, and which is known under the name of black pitch. Its surface, though smooth, has a dull appearance.

I must here observe that it ought to be distinguished from naval pitch, which has a smooth shining surface: the latter is produced from the pine and the spruce fir, altered by the action of heat in the preparation of tar.

TAR. LIQUID BLACK PITCH. BRAI GRAS. TARC.

The different processes hitherto applied to turpentine, or the resin resulting from the desiccation of it, in order to modify its state and consistence, or to multiply its uses, have not such an influence over its nature as to occasion any alteration in it, and much less to produce a partial destruction of it. The degree of heat employed only gives it a specific liquidity, which in no manner deranges its composition. Even the distillation, which furnishes essence of it, extracts merely the more subtile and volatile part, which under the influence of the air and of the sun would have been lost. But when converted into pitch the case is not the same. The degree of heat required for this operation, being higher, must destroy the vegetable organization, and reduce it to charcoal. The resinous substance escapes complete destruction only in consequence of the fluidity it acquires, and of the water of vegetation it carries with it.

PROCESS FOR MAKING TAR ACCORDING TO THE GERMAN METHOD.

Various substances, which in appearance are very different, furnish tar. Several processes are employed for obtaining it; but in whatever manner extracted, whether from coals, turf, or wood, the results are the same, as far as relates to the oily product, which is the principal object. These processes vary according to the nature of the matters employed.

In some parts of Germany, and particularly in the duchy of Deux-Ponts, the mountaineers perform this operation in furnaces of a very simple construction. They consist of a square chimney, the base of which is inclined towards one of its lateral parts, and in the bottom of it is formed an aperture, through which the product is conveyed to an external reservoir.

This furnace is filled with pieces of old resinous fir, split, and placed in a vertical position close to each other. When the furnace is full it is kindled at the top, and when completely on fire it is covered with earth, in the same manner as in the process employed for burning common charcoal.

The heat being gradually communicated downwards, liquefies the resin, which flows towards the lower part by the help of the resinous sap and the water of vegetation, and carries with it the carbonaceous parts. It then passes into the exterior reservoir, where it escapes the action of the heat, and is removed thence by the workmen and put into casks.

This still resinous oil is thicker or thinner, according to the age of the wood employed for the operation. The older the firs, the more they abound with resin.

When the operation is finished, the charcoal which has been left is taken from the furnace. By these means a supply of this article is obtained for the use of the mines, and for other purposes. It is observed that the sum of the product forms nearly a fourth of the wood employed when it is very resinous. The charcoal forms nearly a third.

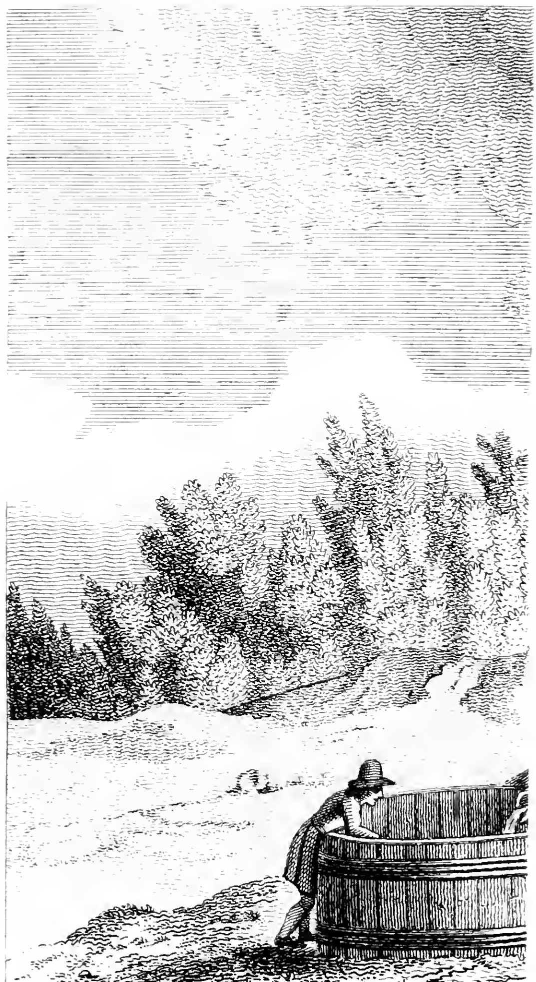
PROCESS FOR OBTAINING TAR ACCORDING TO THE RUSSIAN METHOD.

In Russia this operation is performed on a larger scale, and in a more œconomical manner. The immense forests with which the vast deserts of that empire are covered, and the distance of towns and villages, which lessens so much the consumption, leave to the purchasers of them, when those they have chosen are not in the neighbourhood of a mine, only one object to be accomplished, which is that of making tar.

The resinous wood is cut into pieces of different lengths, according to the purposes to which it is to be applied. Those destined to form the frame-work or sides of the furnace, A, (*Plate I.*) are longer. Those from which the tar is to be extracted are cut into shorter pieces of equal length. This length, in general, is three or four feet*.

* See B, Plate II. which represents a section of the furnace.

Pl. I.



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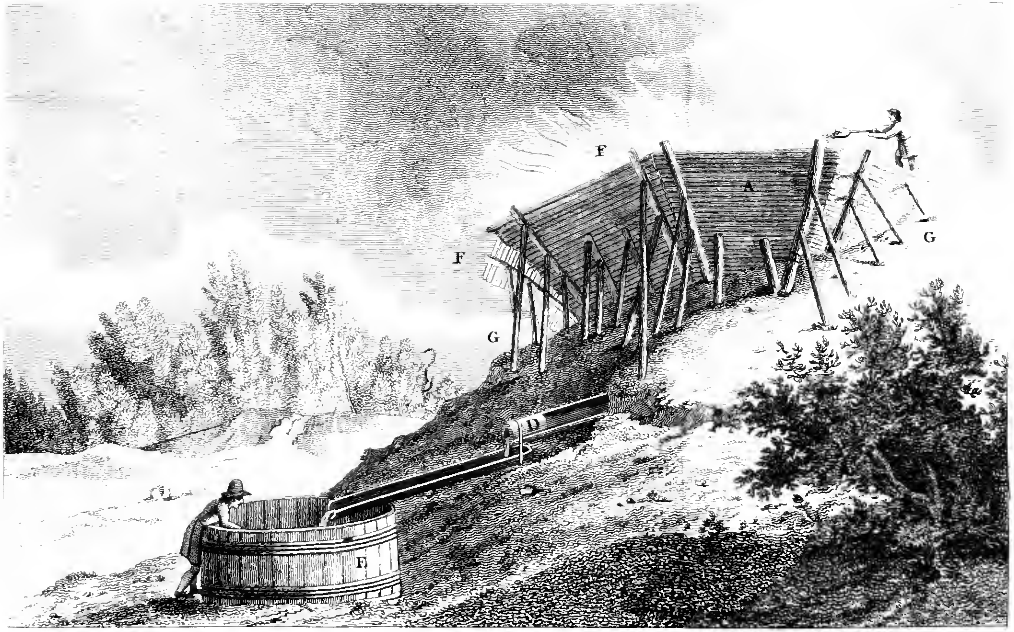

Mutlow & Rigell sc.

Arrangement of the large furnaces in Russia for making Tar

A circle is traced out on some eminence, as at C, (*Plate I.*) The ground is dug in the form of a funnel, and at the bottom of it is constructed a small conduit, D*. The declivity of the ground admits of this conduit being inclined, to facilitate the flowing of the tar from the centre of the furnace to the exterior reservoir E†.

In consequence of the nature of the ground, the operation may sometimes be performed with less expense than is required when it is necessary to surround the furnace with a kind of wall, A: but on other occasions all the materials are arranged on the outside, as seen *Plate III.* In this case the reservoir E is formed in the ground.

When it is not possible to give to the excavation a sufficient depth to contain all the wood destined for this operation, and to leave at the same time a sufficient declivity for the free escape of the oily product, an exterior wall, A, (*Plate I.*) is constructed, and of such a height above the ground as may be judged necessary. This wall is composed of the trunks of trees placed above each other in a horizontal direction, and retained in that position by several posts, F, of a proper length, fixed obliquely in the ground, and supported by a number of stays, G, which give great strength to the whole construction.

When the work is completed, the inside of this large inverted cone is covered with a stratum of fat earth, H, (*Plate II.*) about six inches in thickness, to

* See the section of the furnace, Plate II.

† See Plates I. and II.

secure the exterior wall from the effects of the fire. The pieces of wood, B, cut of equal size, are then arranged vertically around the inside of the cone, so as to form concentric circles, until the whole cavity is filled. In consequence of this symmetric arrangement the point of contact is interrupted in the centre by the diameter of the pieces of wood, and a kind of chimney is formed, which extends from the bottom to the upper part of the cone. This chimney, which is a continuation of the conduit D, is of great utility, as it affords a passage to the air. When the cone is filled, a circular stratum of shavings is placed over the last stratum of wood; and these being kindled, they are afterwards covered with earth, I, to graduate the combustion, as is done in the process for making common charcoal.

The resinous matter liquefied by the heat communicated to the interior parts flows down with the resinous sap, which facilitates its escape through the numerous interstices left between the pieces of wood, and, proceeding along the conduit D, formed at the bottom of the cone, is conveyed in the state of tar into the reservoir E, from which it is put into casks. By this process it undergoes a commencement of decomposition, which often renders it very thick, and it carries with it carbonaceous parts, which communicate to it a black colour.

The least product of one of these furnaces, the circumference of which is four Russian fathoms, or nearly twenty-eight feet, is thirty barrels of tar.

The arrangement of these furnaces is not always the same. Some give to the heap of wood an oblong form,

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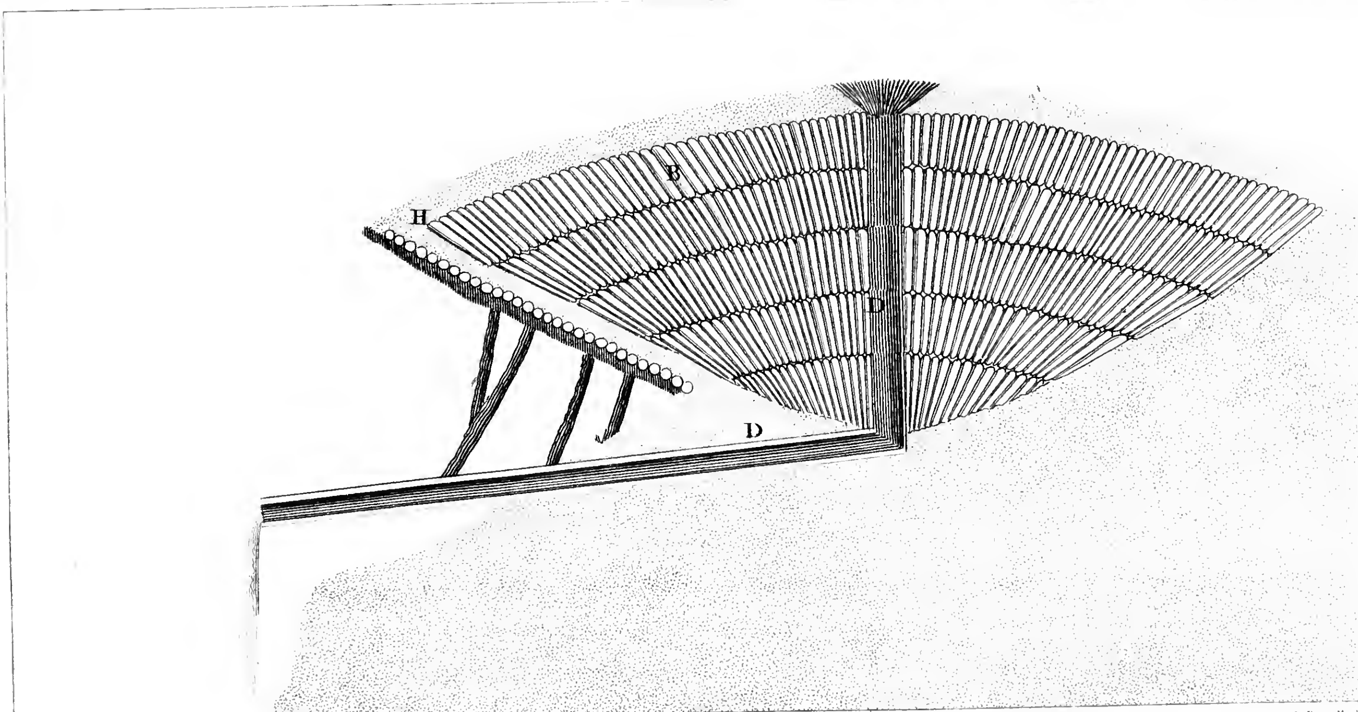

Mulow Sc. Russell Co.

make it about ten or twelve feet in height, and construct it in such a manner as not to require the support of stays. They first erect an outer wall, composed of trees, in the extremities of which they make deep notches, and place them horizontally above each other, those at the sides being joined to those at the ends by means of the notches, so that in consequence of this arrangement the whole acquires considerable strength. The inside is lined with a stratum of well wrought clay, and the bottom terminates in a gutter sufficiently inclined to facilitate the escape of the product, which is conveyed into a reservoir dug out in the earth before the furnace, and lined also with clay. The pieces of wood are arranged as in the preceding case; and a stratum of shavings being placed over them, they are covered with a stratum of earth as soon as they are in a state of complete combustion*.

BLACK SOLID PITCH WITH A SMOOTH SHINING SURFACE.

Black smooth pitch has often been confounded with naval pitch; and these denominations have even been considered as synonymous. Black pitch is a constant object of commerce; but naval pitch is prepared in the sea ports at the time when it is employed.

Black pitch, which is transported in casks, is of a darker or lighter colour. It appears to be dry and friable, but flows and extends itself when exposed to a mean temperature. It is believed to be a compound of the more solid part of tar mixed over the fire with

* See Plate III.

resin. Black pitch of a good quality, when broken by a sudden stroke, ought to be smooth, pulverulent, and exceedingly brilliant on the fracture. This kind of pitch is that used by locksmiths for varnishing articles which they wish to preserve from rust, such as locks, latches, and bolts destined for the doors of cellars, and of other places exposed to moisture. For this purpose, nothing is necessary but to heat the article, and to rub over it a piece of this pitch, partly wrapped up in paper, that it may not stick to the hand. The heat of the metal liquefies the pitch; and as it soon dries the resinous part that has been applied, the result is a black, durable, and shining varnish.

NAVAL PITCH.

Naval pitch is a substance which participates with black pitch in some particular characters, though it differs from it by the nature of its composition, and the uses to which it is applied. It consists of a mixture of black solid pitch, colophonium, and black liquid pitch, or tar, melted together over the fire. The result is an artificial black pitch, to which is added a new quantity of colophonium, or gallipot, and tallow. This mixture is very common in sea ports, where it is known under the name of naval pitch; and is employed for paying ships' bottoms before they are launched. Sulphur is sometimes mixed with this kind of varnish, to render it stronger and more durable.

LAMP BLACK.

Turpentine dried, and reduced to the state of dry resin, and the refuse of all the different kinds of resin, Pl. III.

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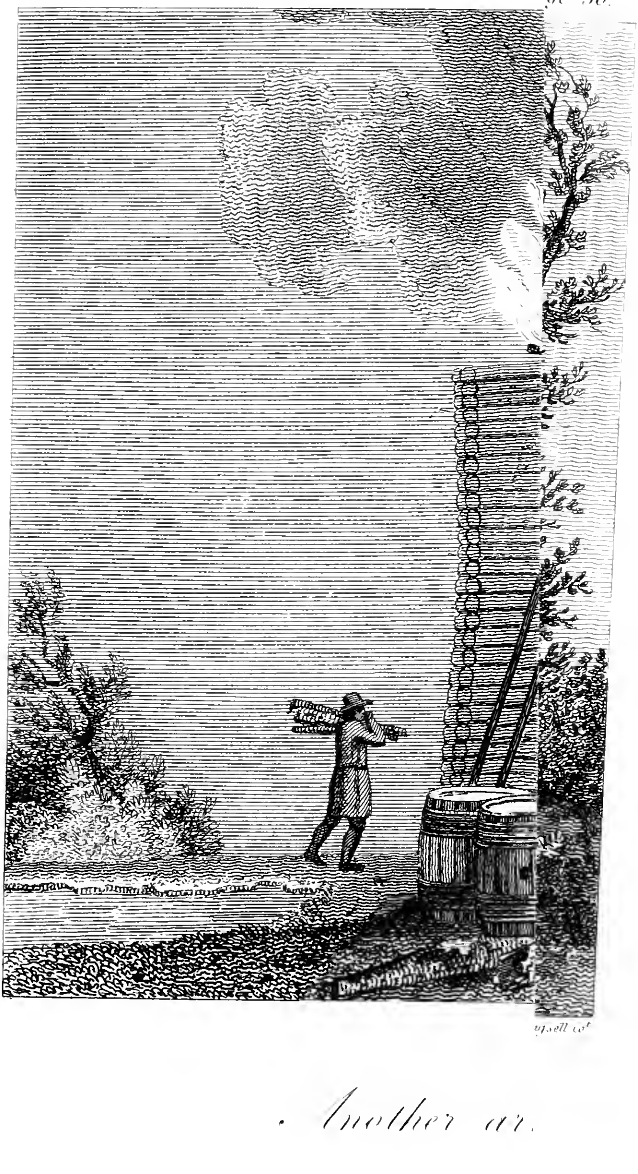

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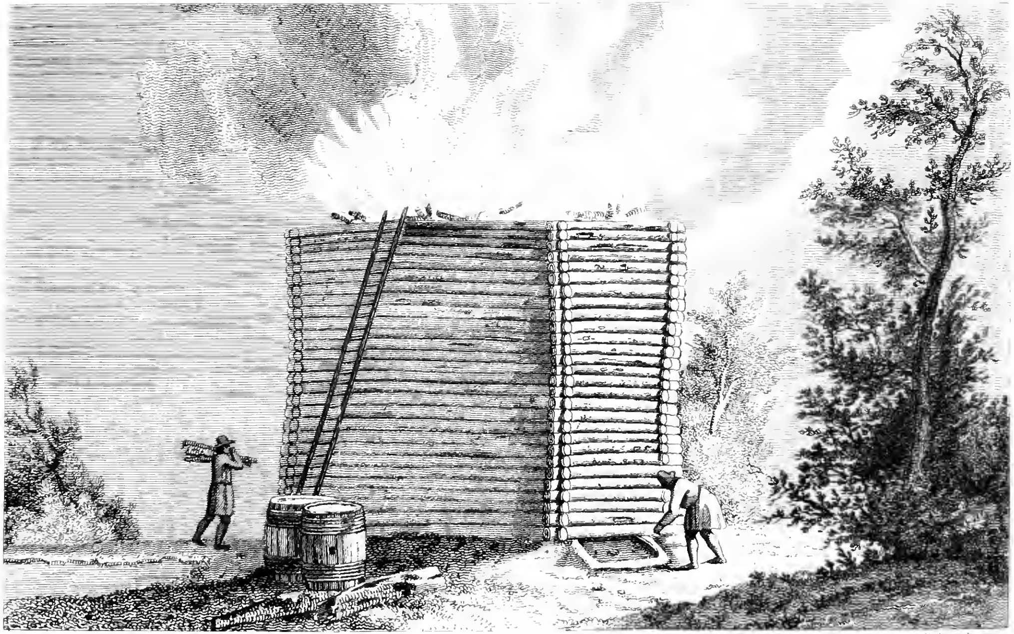

Mutlow Fc.

Another arrangement of a furnace for making tar.

produce, in the act even of their combustion, a fuliginous substance, or real black pulverulent soot, greasy to the touch, known under the name of lamp black. It is much used in painting, and constitutes the colouring part of printers' ink, which is a real oil varnish.

It is manufactured on a large scale in Germany, and even at Paris. It is collected in a small chamber constructed in some place remote from houses, to prevent the danger of fire. This chamber is called *sac-à-noir.*

Its dimensions are proportioned to the quantity of the materials destined to be employed, and the construction of it is very simple. It is a kind of square tent, composed of poles placed in a perpendicular direction, and lined with canvas, which forms the sides and the roof. Instead of canvas, sheep skins well stretched are sometimes employed. When canvas is used, it is often covered with strong paper pasted over it. No aperture is left to afford a passage to the smoke, which rises from the matters in a complete state of ignition.

Iron kettles filled with pitch broken into middle-sized fragments, or the remains of resin and old liquid turpentine, are placed in the middle of this chamber. When the remains of turpentine are employed, sulphurated matches are thrust into the mass. It is then set on fire; and when combustion is fully established, the workman leaves the chamber and shuts the door very closely. The smoke which rises is accompanied with a great deal of soot, which adheres to the interior sides of the chamber. The same operation is repeated till the sides are sufficiently covered with soot, which is afterwards detached by beating with rods on the outside of the canvas. The soot is then collected by sweeping it together with a broom.

If the floor is not paved, the soot often becomes mixed with dust and dirt, which is separated by putting the lamp black into a vessel half filled with water. The foreign bodies are precipitated to the bottom; and the lamp black, which on account of its greasy nature floats on the water, is removed by means of a skimmer: it is then spread out in the air to dry.

Lamp black is of various qualities. When resins only are employed, the soot which thence results is dry, and exceedingly fine; but when old grease is mixed with the resins, the quality of the black is very inferior. In this case it is heavy, and of the nature of grease.

This series of processes applied to one substance shows what may be accomplished by the power of human industry when its activity is properly stimulated. Men have not confined themselves to the apparent results obtained from direct operations: induced by the characters of analogy which seem to exist between resins converted into tar, and that substance which naturalists distinguish by the name of *maltha, mineral oil or pitch, and pissasphaltum*, they have imagined, perhaps too readily, that the circumstances which accompany those combinations effected in the interior parts of the earth, or in the neighbourhood of volcanoes, ought to have a more uniform influence than our chemical processes: hence the preference which painters give to natural bitumen, and in particular to asphaltum, over resins of that kind which art exhibits to us disengaged from every earthy principle and every heterogeneous substance.

This account of the physical and chemical properties of turpentine, and its different modifications, may to some perhaps appear too diffuse. To me, however, it seems to be highly interesting; because it possesses the advantage of exhibiting under the same point of view, and in an order not to be found in any other author, operations of which a correct idea is not always formed, and of which the results ought to be known, not only by those who destine themselves to the practice of the arts, but by all those whose taste leads them to study them in detail, and to examine their different processes.

Besides, there is not one of the substances mentioned, in examining the nature of turpentine, which does not contribute either directly or indirectly to the art of the varnisher. All of them concur in their kind to the formation of particular compositions, the union of which constitutes the whole of the art here described. This object alone has appeared of sufficient importance to induce me to subjoin some engravings, which will enable the reader to comprehend more clearly the nature of a process entirely unknown in our part of Europe: for the drawings from which they were executed I acknowledge myself indebted to a learned foreigner, who had an opportunity of seeing the operations performed.

CHAPTER II.

Of the fluids which serve as an excipient or vehicle to varnish, and which painters denote by the improper name of solvents.

THE fluids which enter into the composition of varnishes are few in number, and do not always possess those qualities which they ought to have. This circumstance renders it necessary that those who have occasion to use them should be well acquainted with their chemical properties, as they all require some preliminary preparations to render them fit for the purposes to which they are applied. This circumstance demands some particular details, which form the subject of the present chapter.

The liquids employed in the art of varnishing are alcohol (highly rectified spirit of wine), ether, essence or oil of turpentine, such as is sold in the shops; ethereous essence or rectified spirit of turpentine, oil of spike, and essential oil of lavender.

These liquids are exceedingly light; they become volatilized when exposed to a degree of heat equal and even inferior to that of boiling water. This character of volatility, which varies according to the particular nature of each liquid, determines the different degrees which varnishes exhibit in their drying quality.

Besides these fluids of a volatile nature, the varnisher employs others more fixed, and which do not become volatilized unless when subjected to a degree of heat greater than that of boiling water, because they then experience a commencement of decomposition: this temperature is foreign to the manipulations of the varnisher. Of this kind are fat or fixed oils, such as oil of pinks, nut oil, and linseed oil.

The unctuous nature of the latter would oppose a permanent obstacle to the desiccation of varnish, had not art discovered means to remove it. These fat oils, then, must undergo particular preparations, which give them a drying quality; and when thus modified they become the most convenient vehicle and excipient of every kind of varnish destined for covering bodies exposed to blows, to friction, and to the influence of the weather.

Several chemists and all artists are accustomed to consider them as performing the office of a solvent in the preparation of varnish. It is not, however, under this point of view that we ought to follow their action on the solid bodies presented to them. Every real solvent changes the form and modifies the nature of the substance which it lays hold of. The liquid body and the solid body are not what they were before: their physical properties have disappeared under the influence of the chemical properties. Evaporation makes no change in the actual result of their union, and a series of chemical means are necessary to bring them back to their former state. The denomination of solvent may, therefore, be happily applied to an acid such as the nitrous acid (aquafortis), when united to a metal, an earth, or an alkaline salt; but this expression is improper when the action of the liquid is confined to a simple solution, such as that which water exercises on a saline body. This action of the water makes no change in the state of the salt, or in that of its substance; since simple evaporation is sufficient to restore both of them to their former condition.

The case is the same with alcohol, essential and fat oils, when applied to resins, balsams, bitumen, &c.: the result is merely particular solutions. The dissolved body being reduced to a state of extreme division, by the effect of solution, deposits itself, with all the advantages attached to that great division, on the wood, metal, or stone, and remains there with all its former qualities. It is more or less electric, and such as it was before mixture: in a word, it may exhibit all the chemical phænomena, or phænomena of decomposition, which it would have produced under its first form.

Varnish, then, is merely the result of simple solution; of a mechanical division of a resinous or gummo-resinous substance, effected by that fluid best suited to its nature: in a word, it is not a dissolution*. I

* The French chemists make a distinction between the terms *solution* and *dissolution*. Solution is the division of the parts of any salt in water. Dissolution is the division of a metal in an acid. These two operations have no resemblance. In the solution of salts the saline moleculæ are only separated from each other; neither the salt nor water experiences any decomposition, and both may be recovered in the same quantity as that which they formed before the operation. The same thing may be said of the solution of resins in alcohol or other spirituous liquors. But in the dissolution of metals in an acid there is always a decomposition either of the acid or of the water: the metal passes to the state of oxide, and a gaseous substance is disengaged, so that after the dissolution none of these substances is in the same state in which it was before: decomposition and recomposition, therefore, have taken place. TRANS.

thought it necessary to give this short explanation before I proceeded to examine the fluids employed in the composition of varnish.

OF ALCOHOL (RECTIFIED SPIRIT OF WINE).

Alcohol is the product of the distillation of wine. By this operation it is obtained of different degrees of purity. The first distillation gives weak alcohol (brandy). Repeated distillations contribute towards its rectification, and at length produce pure alcohol (rectified spirit of wine).

At the period when the pneumatic chemistry arose on the ruins of that of Stahl, the theory of the composition of alcohol had become a kind of problem, the solution of which was attended with some difficulties. One hypothesis was in direct opposition to another. Several celebrated chemists however discovered, by the result of their experiments, a new route, which seemed likely to conduct them to the object of their research. They varied their processes in a thousand ways; facts were accumulated; and by the help of these materials they reared the modern theory of chemistry: I here allude to the pneumatic doctrine.

The composition of alcohol then ceased to be a problem. The process of fermentation, which is spontaneously established in the juice of the grape, or of fermentable bodies, modifies in such a manner the principles of the sweet and saccharine bodies found in them, that the result is a liquor composed of hydrogen (one of the principles of water) and a little carbon (charcoal). This liquor, blended with a great deal of the water of vegetation, a colouring part and different salts, which are foreign to it, constitutes wine. Distillation carries off the spirituous part mixed with a large quantity of water; and by repeating this operation the water, which does not exist in a state of combination, is separated. The union of hydrogen and carbon in alcohol does not appear to be free from oxygen (another principle of water); for the inflammable part of alcohol is found in the oily state, or approaching towards it.

Alcohol is one of those substances which have not a fixed degree of tenuity or of purity. That commonly sold in the shops is never pure: it is more or less mixed with water, which weakens its force. Tasting cannot serve as a guide in the choice of this article. The case is the same with the Dutch proof; an arbitrary method, which determines the state of purity of alcohol merely by the slower or speedier disappearance of the crown of bubbles produced by shaking some of it in a phial.

Watin judiciously observes, that weak alcohol, on account of the great quantity of water mixed with it, is improper for the composition of varnish. Setting out from this principle, he says the best alcohol ought to be chosen; but the proof by gunpowder, which he recommends, has been found to be insufficient. The certainty of this kind of proof depends on two circumstances, which require care and practice. 1st, The state of the metallic vessel which serves as a receptacle. 2d, The quantity of the gunpowder employed for the experiment.

If the vessel in which the proof is made be thick, it acquires a strong heat; and the effect of this heat is, that it evaporates a part of the water contained in the alcohol: it is this water which moistens the gunpowder, and prevents it from inflaming.

This obstacle, however, might be removed by placing the vessel in a bason of cold water, and keeping the bason in a state of agitation.

The second inconvenience arising from the quantity of the gunpowder is such, that it may easily be made to detonate with weak alcohol, and not to detonate with alcohol of a purer quality. These tricks are well known to merchants. When a large quantity of gunpowder is employed, and when heaped up in the form of a pyramid, it happens towards the end of the experiment, and when the liquor is very much diminished, that the point of the pyramid soon rises above the surface of the inflamed liquor. The exterior grains of the gunpowder speedily lose, by the effect of the heat communicated to them, the moisture they had imbibed, and detonate before the whole liquor has evaporated.

The same experiment repeated with alcohol of a good quality, under which only a few grains of gunpowder are placed, is not attended with the same success, because the small quantity of water deposited by the alcohol is sufficient to penetrate the small quantity of gunpowder, which, in consequence of the small space it occupies, cannot be uncovered before the end of the inflammation.

I should not attempt to excite any doubt in regard to these means which are commonly employed by artists, to whom it is of importance to be well acquainted with the substances they use, were I not able to substitute more certain processes in their stead.

There are two methods very efficacious, and which alone ought to be employed, to determine the choice of this article: these are the hydrometer, and taking the specific gravity, attending at the same time to the temperature, which ought to be from 55 to 60 of Fahrenheit*.

When the artist finds it necessary to rectify his own alcohol, it may be obtained very pure by following Baumé's method. Reserve the first third of the product of each distillation; then unite all these first products, and, having distilled them again, reserve for your varnish the two first thirds of the product. The remainder may be employed for new distillations, or for other purposes. None, however, but amateurs or enlightened artists will think it worth while to attend to these minutiæ: common artists will not take so much trouble, notwithstanding the great benefit they would derive from these operations in the use of resins, a much larger quantity of which is taken up by pure alcohol than by alcohol of an inferior quality; and besides this, the varnish becomes brighter, more durable, and more drying†.

* The author here recommends Baumé's areometer, an instrument not to be met with by English artists. But they may easily try themselves, or get some person who has a proper balance to try, the specific gravity of the alcohol they use, which ought not to be greater than 815, water being taken at 1000. Alcohol of this strength may be had at Apothecaries'-hall.---TRANS.

† Some artists, desirous of giving to alcohol those qualities which

Alcohol exercises an action on resinous matters proper for the composition of varnish, only in proportion to its purity. By the word *proper* is here meant real resins: for though different treatises on varnish, and even Macquer in his excellent Dictionary of Chemistry, place resinous gums on the same footing as resins; in regard to such compositions, it is certain that they are not proper for those from which a brilliant and colourless varnish is expected. This error arises, no doubt, from the false appellations under which artists were accustomed to denote the greater part of those matters employed as the basis of varnish. It was thus that they gave the name of resinous gum, or simply of gum, to substances purely resinous; such as gum anima, gum elemi, gum tacamahaca, gum guttæ, &c.

It is, however, rather as an artist than as a chemist that I endeavour to set bounds to the action of alcohol; because, at present, I consider only those material substances capable of furnishing to varnish a solid base, the more or less perfect extension of which over the body to be varnished constitutes that glazing, which exalts and heightens, when exposed to the light, the material colours applied to them.

are necessary for making varnish, have applied to it different agents, such as carbonate of lime (chalk), carbonate of potash (vegetable alkali or potash), with a view to free it from its superabundant water. The latter process, recommended by Boerhaave, separates from it a liquor denser and a little more coloured than the supernatant alcohol; but the alcohol is a little altered, it is as it were oily. Besides, this process, if necessary to be performed on a grand scale, would be tedious, and more expensive than distillation.

Alcohol may be of use also in the art of varnishing, in consequence of the property it possesses of becoming charged with certain colouring matters; but these colouring parts alone would not always constitute varnish: besides, in regard to this use, their number is very small, since it is confined to one species; that is, the changing varnishes. In a word, if these colouring parts have the property of contributing, in certain cases, to the splendour of a composition, they add nothing to its essential principle, that is, its durability.

OF ETHER.

Ether, like alcohol, is an artificial production. Alcohol treated with an equal quantity of sulphuric acid (oil of vitriol; that is, sulphur united to oxygen, the base of pure air,) assumes characters which seem to assign to it an intermediate place between alcohol itself and the lightest essential oils. It divests itself of a part of its water, a principle which rendered it miscible with water; and it acquires, by the operation to which it has been subjected, new physical and chemical properties which make it a new agent, exceedingly useful in certain arts, and particularly in chemistry, where it is employed in the nicest analytical researches.

During the operation, the alcohol divests itself of a small quantity of carbon (charcoal) and a great deal of water, which it exchanges for a new quantity of oxygen; and the latter communicates to it characters which bring it near to the nature of the lightest essential oils.

Ether is exceedingly volatile, has an agreeable odour, different from that of alcohol, and a penetrating savour, not hot and irritating like that of alcohol. By repeated shaking, a part of it may be united to water; but the rest floats on the surface of the water as pure oil would do.

Its specific gravity is a sixth less than that of alcohol, which serves as the base of its formation. Its action on resins is not so extensive as that of alcohol. A mixture of the smallest portion of extractive, gummy, or mucilaginous matter is capable of weakening its energy on the resinous part, whatever may be its quantity. The application of it is not successful but with pure resins. In this case it becomes an agent very much superior to alcohol and to every other fluid. Copal, the characters of which seem, in some respects, to be confounded with those of amber and caoutchouc, known under the name of gum elastic, attest, in this point of view, the superiority of ether to alcohol.

But this liquor does not always possess that quality requisite to make it answer those purposes for which it seems most likely to be useful. Ether, in the same manner as alcohol, has degrees of purity which depend on the care and intelligence of the chemist who prepares it. Among the gases disengaged during the preparation of it, there is one, the sulphurous acid, which in some measure weakens the power of ether over copal, which requires that this agent should be in a state of the greatest purity.

I confine the employment of this volatile liquor to the composition of copal varnish, and by addition to that of caoutchouc varnish. It might indeed be applied to the composition of other kinds but the dearness of it will always prevent the use of it being extended to common varnishes.

Watin and the artists who preceded him say nothing of ether; but a chemist of Paris, Cadet the academician, had an idea, I believe, of extending the use of this liquor to varnish, by taking advantage of the remains of the distillation of ether, from which more may be formed by adding new doses of alcohol. This idea, however happy it may at first have appeared, was not favourably received by artists who were most interested in adopting it. The œconomy which might have struck the chemist in employing this residuum was not sufficiently apparent to the artist. Besides, the labour on a large scale which requires the use of a very high temperature, does not agree with the great expansibility of ether, and it would be necessary that artists should possess something more than common abilities to foresee the consequences.

I should myself have observed silence in regard to the use of this liquor, had not a powerful reason induced me to pay attention to the solution of copal, in order to make a particular varnish, the destination of which does not occasion much consumption. Living in a city celebrated in various points of view, but particularly for the extent of its manufactory of enamelled articles, which has been carried to the highest degree of perfection, it was proper that I should point out the easiest and speediest means of repairing, in a durable manner, the various accidents which befall such articles when they are out of the workman's hands. The high price of those toys will admit of these accidents being repaired with a kind of varnish which is indeed expensive, but endowed with all the required qualities, such as splendour, durability, and readiness of evaporation.

ESSENCE OF TURPENTINE.

Commerce makes us acquainted with a very odorous oil, highly inflammable, more or less coloured, and of a greater or less degree of fluidity, which is distinguished by the name of essence or oil of turpentine.

The acceptation of the term essence is not the same to the chemist and the perfumer. According to the former, this word expresses that part of a mixture or compound which is susceptible of being separated by the application of heat. He gives the name of essence to the sweet volatile part, which he separates by distillation from aromatic substances: hence all the essential oil, volatilized in the course of the operation, is distinguished by the collective name of essential oil or essence. According to the perfumer, as well as to certain artists, the term essence denotes the union of one or more essential oils with alcohol (spirit of wine). Thus essence of lemons, bergamot, lavender, rosemary, &c. is alcohol impregnated with the aroma (odorous principle) and a portion of the essential oil of these fruits, flowers, &c.

It is not under the latter point of view that we ought to consider essence of turpentine. It is an essential oil extracted from turpentine by distillation. The lightest and the least coloured is that which ought to be employed for varnish.

Though this oil is common, it is subject to that spirit of adulteration which unfortunately is extended to the simplest articles of commerce. It may be mixed with common alcohol or fat oils of little value, such as that of the seeds of the white poppy, known under the name of oil of pinks. In both these cases the essence is altered, and the use of it would be hurtful in the preparation of varnish. Water united to weak alcohol (brandy) opposes the solution of resins. Fat oil, though less dangerous, would render varnish unctuous, glutinous, and difficult to dry. The first kind of adulteration may be known by pouring a little of the essence into a phial filled with water to the neck; placing your finger on the mouth of the phial, and giving it two or three shakes. If the essence is pure, it divides itself into small, bright, limpid globules, which soon resume their former situation and volume. If it be mixed with alcohol, its extreme division renders the water milky, and the volume of the supernatant oil is not the same.

In regard to the adulteration by fat oil, it may be detected also by the following sure method: Impregnate the surface of a bit of paper with this essence, and hold the paper before the fire. Pure essence will evaporate completely without leaving any traces on the paper, on which you may afterwards write. If it be mixed with fat oil, the paper remains transparent, and refuses every impression of writing.

When alcohol is at hand there is still a speedier method. Add a few drops of essence to an ounce of alcohol: if the essence be pure, the alcohol becomes charged with it; if mixed with fat oil, the essence passes into the alcohol, but the fat oil is precipitated entirely to the bottom. If you wish it, you may easily ascertain the proportions which have been observed in the quantity of the two oils.

I shall here give to this essence a chemical character, which Watin in his work has refused to it. In the first edition, p. 60, he announces that essence of turpentine does not mix with spirit of wine. He here no doubt means, that this mixture cannot be made in those proportions which might be necessary to render it fit for the preparation of varnish. It is certain that alcohol becomes charged with it in relative proportions, according to the consistence of the essence. The lighter it is it takes up the less, and *vice versa*. The best alcohol can take up no more than a third of its weight of common essence, and a seventh or an eighth part of the lightest.

The same author considers as a distinguishing character of the best essence the difficulty it exhibits in its union with drying oil, which forms a principal part of amber and copal varnish. Very often this union is not complete till five or six minutes after the vessel has been taken from the fire, notwithstanding the state of agitation in which the matters have been kept. This effect depends entirely on the difference in the specific gravity of the two oils, and particularly on the state of the consistence or inspissation of the drying oil. The variations which may take place in regard to these two circumstances produce relative results. The motion excited in the mixture, by the means of caloric (heat), opposes in part the union of the lighter essential oil of turpentine: it indeed remains a long time at the surface, and does not begin to incorporate but in consequence of the circular motion which is maintained, and when the action of the greatest heat ceases.

ETHEREOUS ESSENCE OF TURPENTINE. RECTIFIED SPIRIT OF TURPENTINE.

If the influence of merited reputation induced the amateur of an art never to deviate from an opinion pronounced by an expert master, the progress of the arts would be slow, and errors would long enjoy the privilege of misleading the inquisitive genius, who examines every thing susceptible of improvement. Setting out from this principle, we might give some importance to the idea of reprobation which Watin attaches to the nature of ethereous or light essence. This author announces that essence can be useful only for fat varnishes, in order to facilitate their extension, and that ethereous essence has too little body to be applied to varnishes.

If this author, whose work is held in considerable esteem, had distributed his compositions for varnish into classes or genera, according to the different uses to which certain compositions may be applied, he would not have emitted so decisive an opinion. Experience, which produces and improves the arts, has induced me to pay little attention to that importance which is generally attached to the decision of a master. Experience therefore shall be my guide, because it is by it alone that our opinions ought to be regulated. It appears to me that the application of ethereous essence of turpentine should be confined to the composition of varnish for valuable paintings. The proprietors of the finest collections are continually recommending the use of it, as it has more body than alcohol.

There are two methods of rectifying essence of turpentine to render it light and colourless, and to give it a less disagreeable and incommodious smell than common essence.

First Method.

Pour into a glass retort, capable of containing double the quantity of matter subjected to experiment, three parts of common water and two parts of the essence of turpentine. Place this retort on a sand bath; and having adapted to it a receiver five or six times as large, cement with paste made of flour and water some bands of paper over the place where the two vessels are joined. If the receiver is not tubulated, make a small hole with a pin in the bands of cemented paper, to leave a free communication between the exterior and the interior of the receiver: then place over the retort a dome of baked earth, and maintain the fire in such a manner as to make the essence and the water boil.

The receiver will become filled with abundance of vapours, composed of water and ethereous essence, which will condense the more readily if all the radiating heat of the furnace be intercepted by a plate of copper, or piece of board, placed between the furnace and the receiver. When the mass of oil subjected to experiment has decreased nearly two thirds, the distillation must be stopped. Then leave the product at rest, to facilitate the separation of the ethereous oil, which is afterwards separated from the water, on which it floats, by means of a glass funnel, the beak of which is stopped by the finger.

This ethereous oil is often milky, or merely nebulous, by the interposition of some aqueous parts, from which it may be separated by a few days' rest. The essence, thus prepared, possesses a great degree of mobility, and is exceedingly limpid. It is only when it exhibits these two characters that it is thought proper for the composition of varnish.

The second method cannot be employed but by persons very expert in chemical processes, and who therefore are well acquainted with those precautions which may be considered as essentially necessary to the success of a distillation of this kind. It is the process I chiefly follow, being performed without any intermediate substance.

Second Method.

The apparatus employed in the preceding process may be used in the present case. I fill the retort two-thirds with essence; and as the receiver is tubulated, I content myself with applying to the tubulure a small square of paper moistened with saliva, to afford a free passage to the incoercible vapours. I graduate the fire in such a manner as to carry on the distillation very slowly, until I have obtained a little more than half the oil contained in the retort.

I separate the product from a very small quantity of exceedingly acid and reddish water, which passes at the same time as the ethereous essence: by these means the operation is much shortened.

The oil of turpentine which remains in the retort is highly coloured, and thicker than the primitive essence. It may be used for extending fat varnish, or for coarse oil painting.

The essence, when thus rectified, is lighter than the essence commonly sold in the shops. The former is to the latter as 31 to 32; and the latter is to distilled water as 32 to 36.

Its specific gravity is somewhat greater than that of alcohol; the latter therefore floats on the lightest essence, and essence consequently has more body than alcohol.

ESSENTIAL OIL OF LAVENDER.

The varnisher has not much occasion to make use of this oil, which is better known to the enameller, because it has sufficient consistence to prevent the colours diluted with it from running under the brush.

Besides this advantage, which is not to be found in oils that are too fluid, it retains a sort of unctuosity, which prevents the inconvenience of too speedy desiccation. It is on account of this quality that it is most interesting to the varnisher. It is indeed employed in the composition of mordants, to which it communicates a sufficient degree of unctuosity to give the painter time to sketch out the design, which the gilder afterwards fills up.

This essential oil is extracted by distillation from a certain quantity of the flowers or tops of lavender. The calyx of these flowers contains a great deal of this oil, which is volatilized in vapour with the water, at the temperature of boiling water, and which is afterwards separated from the water over which it floats.

Though this process is followed on a pretty large scale in the southern provinces of France, which seem to be the true country of aromatic plants, we must not believe that the essential oil extracted in them is brought to us in a state of purity. Essence of turpentine, which is far more common, is always mixed with it; and it is by this addition that the distillers maintain among themselves a competition which is always to the disadvantage of the consumer. It is needless, therefore, to point out the means of detecting an adulteration universally known, and which it is impossible to prevent. I shall only describe the principal characters, which may enable purchasers to be on their guard against too excessive a degree of sophistication.

The addition of the essence of turpentine ought to be considered as too strong, when the fluidity of the oil of lavender approaches too much to that of the essence, and when the odour of the plant is so concealed by the latter as to be scarcely perceptible.

Another kind of adulteration, as lucrative to the distiller as it is prejudicial to the essence of lavender, destined for the composition of varnish and for painting, is practised by mixing it with fat oil, such as oil of behen or oil of pinks. I have already detailed the means of detecting this adulteration in treating of the essence of turpentine.

ESSENTIAL OIL OF SPIKE.

Oil of spike is the result of the distillation, on a grand scale, of a kind of lavender with larger leaves than that which grows in our gardens. This plant is very common in the ci-devant Languedoc. In regard to the oil which it furnishes in great abundance, it is impossible to find it pure in the shops. What is sold there emits a stronger or weaker smell of turpentine, in which is perceived a slight balsamic odour of the plant from which it takes its name. Painters are so fully convinced of the impurity of this oil, that they no longer use it. The varnisher, who perceives no difference between this oil and essence of turpentine but in the price, does not hesitate to supply its place by the latter; and in this he acts wisely.

Distillers on a large scale bargain sometimes with their consciences; and think they act with great delicacy when they make choice of essential oil of spike to enlarge the quantity of their valuable essential oils; such as those of myrrh, neroli, mint, &c. They reserve the essence of turpentine for oils of less value, such as that of spike when it is required of the first quality.

A process very common in the South of France is, to distil essence of turpentine from off a certain quantity of that plant which is to give the name to the oil extracted in the course of the operation. By this method, the odour peculiar to the plant manifests itself in a more sensible manner than by simple mixture. To be able to discover this adulteration requires considerable practice.

This kind of adulteration, however, is not the only one employed. The addition of alcohol and that of fat oil is not neglected.

OIL OF WHITE POPPY SEEDS, COMMONLY CALLED OIL OF PINKS.

The white poppy, the same kind which in the eastern regions, such as Natolia, Syria, Persia, and Egypt, furnishes opium, is very abundant in many of the countries of Europe.

The oil extracted from its seeds by contusion and expression, a method applied to almonds, is exceedingly sweet and unctuous. On this account it is employed by the Orientals for cleansing and softening the skin.

The great use made of it under different forms in the East, in Bohemia, Poland, and Italy, seems to have been founded on the opinion entertained of the somniferous virtue of these seeds; but it has been proved by a series of excellent observations, that they do not participate in this respect in the properties of the plant which produces them. They afford a sweet oily nourishment; and this may serve to account for the use made of them in certain countries by nurses, who mix them sometimes in broth, and administer it to their children to cure the colic.

The accurate knowledge obtained with respect to these seeds, and the oil they contain, is not older than the beginning of the last century; and it is only owing to the advantages which always result from correct observations and conclusive experiments, that we are indebted for the non-execution of the penalties established by the old police of France against those who mixed oil of pinks with the oils destined for alimentary consumption. Since that period, this oil, confined entirely to painting, in consequence of the shackles imposed on its circulation, has always been sold at a cheaper rate than olive oil, nut oil, &c. However, to set bounds to mercantile avarice in regard to mixtures which might be made of it, government authorized the addition of a French pint of turpentine to each cask of this oil, as being allowed to be used only for painting. This mixture was made at the different offices where the oil was entered.

Oil of pinks is not extracted from the seeds of the white poppy alone: those of the black poppy furnish it also, and it is used in Germany for lamps, for cooking, in salad, &c. In a word, it supplies the place of olive oil to the lower classes.

Oil of pinks is unctuous: like fat oils, it must not be used for painting without proper choice, and it requires a preliminary preparation to be rendered drying. As it has the advantage over other oils of being colourless, it is preferred for delicate kinds of painting. Though age, in regard to this oil, supersedes the necessity of previous preparation, and gives it a drying quality, I shall here indicate the best process for that purpose.

Process for giving a drying Quality to Oil of Pinks.

Into three pounds of pure water put an ounce of sulphate of zinc (white vitriol), and mix the whole with two pounds of oil of pinks. Expose this mixture in an earthen vessel capable of standing the fire, to a degree of heat sufficient to maintain it in a slight state of ebullition. When one-half or two-thirds of the water has evaporated, pour the whole into a large glass bottle or jar, and leave it at rest till the oil becomes clear. Decant the clearest part by means of a glass funnel, the beak of which is stopped with a piece of cork: when the separation of the oil from the water is completely effected, remove the cork stopper, and supply its place by the fore finger, which must be applied in such a manner as to suffer the water to escape, and to retain only the oil.

Oil of pinks when prepared in this manner becomes, after some weeks, exceedingly limpid and colourless.

Remarks.

Many artists reject every preparation of oil in which water has been employed as an intermediate substance. It may, indeed, be dispensed with when they employ coloured oils, with which they mix substances that communicate to them a foreign colour, and which the heat applied to them contributes to render still stronger. The case is not the same with oil of pinks: it still retains enough of its unctuous quality to impede desiccation for some time, and it cannot lose this quality but by age, or by processes which are not very complex. In the process here given the oil becomes charged with a little water, by which it acquires a nebulous appearance, and retains it for several weeks. This interposed water gradually separates itself from it, and at the same time carries with it a mucilaginous matter, a little altered; the complete separation of which adds to the extreme purity of the oil. Perfect limpidity is the surest sign of the absence of all its foreign particles. A slight heat accelerates the clarification of oil prepared with water.

Watin indicates for linseed oil a process which may be employed for oil of pinks also; and which might be simplified by omitting the calcined talc. Nothing is necessary but to expose it to the action of the sun, during the fine weather in summer, in a vessel the bottom of which is covered with white lead, or, what is better, with litharge, inclosed between two pieces of fine muslin. Exposure to the sun for some months is sufficient to free the oil from its greasy particles, and to render it perfect.

NUT OIL.

Nut oil is extracted by contusion and expression from the interior part of the fruit from which it derives its name. It is well known in consequence of the great use made of it as an aliment, and in certain arts. The most common kind, that is to say, the oil extracted by the application of a small degree of heat to the paste, is reserved for lamps; but that extracted without the aid of heat forms a wholesome and nutritive seasoning, which retains an exquisite taste of the fruit.

The burnt taste which this oil acquires, when too much heat is employed to increase the product, is the cause of the preference given to oil of olives in cookery. That destined for the arts is generally the most common. The heat occasioned by the torrefaction it experiences, disposes it in a wonderful manner for the subsequent operations which render it proper for various uses in painting. It is preferred to linseed oil for every kind of painting exposed to the injuries of the air, and particularly to the influence of the sun.

LINSEED OIL.

Of all the fat oils, the one which forms the subject of this article requires the greatest degree of heat in the process of its extraction; and therefore it is always more or less coloured and thick.

Flax seed contains a small kernel, which would give an almost colourless oil like that of pinks, if nothing were required to extract the oil except contusion and expression, as is practised for oil of sweet almonds, and for nut oil of the first quality: but the kernel of flax seed is inclosed in a small hard covering, which is very mucilaginous. The mucilage even is so abundant that it would absorb the greater part of the oil during the expression, had not experience pointed out the necessity of destroying it by a pretty strong torrefaction. During this process there arises abundance of aqueous vapours furnished by the mucilage, which becomes dry, and which in part is destroyed. When the whitish vapour is succeeded by a kind of dry and blackish fumes, the torrefaction is complete, and the paste is then subjected to the press. It may be readily conceived that the preliminary labour must have an influence on the principles of the oil, and alter its purity.

The Dutch follow this branch of the arts on a large scale, and furnish almost the whole of the linseed oil circulated by commerce in France. They conduct the process with more skill than the Germans, who carry the torrefaction of the seed to such a degree as to render the oil almost red.

This oil is destined for the purposes of painting, and particularly for the manufacture of floor-cloths; but to give it that drying quality which these arts require, it is subjected to one of the operations described at the end of this article.

The society* employs other kinds of fat oil, such as that extracted from the seeds of the beech tree, oil of olives, of sweet or bitter almonds, of hemp seed, oil of walnuts, &c. but they all have a character of unctuosity, from which it is difficult to free them. I must, however, except oil of beech seed, so abundant in the department of Aisne, and those of the ci-devant Burgundy and Franche-Comté, which is sold there for common nut oil: and in these countries the painters have never made any complaint against it. Besides, the high price of these oils, and particularly of olive oil and oil of almonds, would add to the reason here mentioned. Painters and varnishers, therefore, adhere

* The Society of Arts, Agriculture, and Commerce at Geneva. Trans.

to the three kinds of oil here described. Linseed oil being inferior to nut oil for painting, is reserved for coarser works.

METHODS EMPLOYED TO GIVE TO FAT OILS A DRYING QUALITY.

First Process.

Take Nut oil or linseed oil 8 pounds*.

White lead slightly calcined, - -	of each 1 ounce.
Yellow acetite of lead (sal Saturni) also calcined, - - - - -	
Sulphate of zinc (white vitriol),	
Vitreous oxide of lead (litharge)	12 ounces.
A head of garlic or a small onion.	

When these matters are pulverized, mix them with the garlic and oil over a fire capable of maintaining the oil in a slight state of ebullition: continue it till the oil ceases to throw up scum, till it assumes a reddish colour, and till the head of garlic becomes brown. A pellicle will then be soon formed on the oil; which indicates that the operation is completed. Take the vessel from the fire, and the pellicle, being precipitated by rest, will carry with it all the unctuous parts which

* The proportions here given, and in all the other formulæ in this work, are according to the old French pound. It is necessary, therefore, to observe that this pound is divided into 16 ounces, each ounce into 8 gros, each gros into 3 deniers, and each denier into 24 grains. Some further remarks on this subject, with a table for converting these weights into corresponding English denominations, will be given at the end of this work.—Trans.

rendered the oil fat. When the oil becomes clear, separate it from the deposit, and put it into wide-mouthed bottles, where it will completely clarify itself in time, and improve in quality.

Second Process.

Take Vitreous oxide of lead (litharge) $1\frac{1}{2}$ ounce.
Sulphate of zinc (white vitriol) $\frac{3}{8}$ of an ounce, or 3 gros.
Linseed or nut oil 16 ounces.

The operation must be conducted as in the preceding case.

The choice of the oil is not a matter of indifference. If it be destined for painting articles exposed to the impression of the external air, or for delicate painting, nut oil or oil of pinks will be requisite. Linseed oil is used for coarse painting, and that sheltered from the effects of the rain and of the sun.

A little negligence in the management of the fire has often an influence on the colour of the oil, to which a drying quality is communicated: in this case it is not proper for delicate painting. This inconvenience may be avoided by tying up the drying matters in a small bag; but the dose of the litharge must then be doubled. The bag must be suspended by a piece of packthread fastened to a stick, which is made to rest on the edge of the vessel in such a manner as to keep the bag at the distance of an inch from the bottom of the vessel. A pellicle will be formed, as in the first operation, but it will be slower in making its appearance.

In this process the oxide of lead, when it is free, and when it rests on the bottom of the vessel, is in a great part reduced. Small grains of lead even are often observed in it.

Third Process.

A drying quality may be communicated to oil by treating in a heat capable of maintaining a slight ebullition linseed or nut oil, to each pound of which is added three ounces of vitreous oxide of lead (litharge) reduced to fine powder.

I have known painters who carried the dose of vitreous oxide of lead to a fourth part the quantity of oil employed. This case is reserved in particular for baked oils used in painting, where speedy desiccation and the greatest degree of durability are required. I have often used drying oil, prepared by extending the dose of the vitreous oxide of lead to a fourth part of the quantity of the oil. The preparation of floorcloths, and all painting of large figures or ornaments, in which argillaceous colours, such as yellow and red boles, Dutch pink, &c. are employed, require this kind of preparation, that the desiccation may not be too slow; but painting for which metallic oxides are used; such as preparations of lead, copper, &c. require only the doses before indicated, because these oxides contain a great deal of oxygen (the base of pure air), and the oil by their contact acquires more of a drying quality.

Nay, I have painted with unprepared nut oil, taking the precaution to add to the pulverized colour vitreous oxide of lead (litharge in very fine powder *), about 3 or 4 ounces for each pound of oil. The painting, in this case, acquired a body as speedily as if baked oil had been employed. This method is expeditious; but it can be practised only with colours which are not susceptible of being attacked by litharge.

Fourth Process.

Take Nut oil 2 pounds.
Common water 3 pounds.
Sulphate of zinc (white vitriol) 2 ounces.

Mix these matters, and subject them to a slight ebullition till little water remain. Decant the oil, which will pass over with a small quantity of water, and separate the latter by means of a funnel. The oil remains nebulous for some time; after which it becomes clear, and seems to be very little coloured. This method is employed by some of the English artists, and I have tried it with success: the oil is rendered somewhat less drying than by the other processes, and is attended with this inconvenience, that it remains nebulous for a very long time, even when exposed to the influence of the sun.

* To reduce the vitreous oxide of lead (litharge) to a state of great division, without incurring the risk with which dry pulverization is sometimes attended, I grind the oxide with water; I then spread out the divided matter in an iron shovel, and place it over a gentle fire. The moisture is soon evaporated, and the remaining matter requires very little stirring when mixed up. This method may be applied with great success to painting in which different kinds of ochre are employed.

Fifth Process.

Take Nut or linseed oil 6 pounds.
Common water 4 pounds.
Sulphate of zinc 1 ounce.
One head of garlic.

Mix these matters in a large iron or copper pan; then place them over the fire, and maintain the mixture in a state of ebullition during the whole day: boiling water must from time to time be added, to make up for the loss of that dissipated by evaporation. The garlic will then assume a brown appearance. Take the pan from the fire; and having suffered a deposit to be formed, decant the oil, which will clarify itself in the vessels. By this process the drying oil is rendered somewhat more coloured: it is reserved for delicate colours.

Remarks.

This method is one of those which require the utmost attention; and therefore by some it has been condemned. If the water mixed with the ingredients, and that added in a state of ebullition during the process, to supply the loss of that dissipated by evaporation, be too abundant, and if towards the end of the operation it be not all made to disappear by a careful evaporation, it will unite itself to the drying oil, and communicate to it the colour and the consistence almost of cream. In this case the oil will clarify slowly; there will even remain an interposed portion, which it will be difficult to separate. This inconvenience seems to justify the censure passed by some artists on this process. However, when well conducted, it affords a very simple method of obtaining oil exceedingly drying, and much less coloured than that subjected to the direct impression of the fire; but it requires to be kept for some time.

House-painters, &c. are less interested than portrait- or landskip-painters, and those who paint decorations, in the different researches which tend to destroy the brown or reddish tint, which is one of the characters of oils rendered drying by the common processes. For brown or dark colours they employ the oil twenty-four hours after it has been prepared, reserving that which clarifies itself by deposition for the more delicate kinds of painting. This, however, is not sufficient; because the least tint communicated to fine colours visibly alters their tone. Researches, therefore, have been made to find out for this particular case processes different from those which we have here described, without excepting even the last.

Watin indicates one for nut oil, which may be applied to linseed oil, and even to that made from the seeds of the white poppy, in case artists should have any objection to employ water as an intermediate substance. This process is attended with complete success, and gives a drying oil free from any foreign colour. I have mentioned it in describing the process for communicating a drying quality to the oil of white poppy seed. In every case in which sulphate of zinc (white vitriol) is employed, according to the English method, without any mixture, it is proper not to carry the evaporation of the water beyond three-fourths of the whole.

In describing the preparation of oil of pinks, it has been seen that water is an intermediate substance proper for keeping the temperature necessary in this operation at a fixed point, and which is incapable of altering the principles of the oil by making it undergo a commencement of decomposition. The well-known property it possesses of being reduced to a state of vapour affords a certain method of avoiding the accumulation of caloric (heat). By varying the process, and following a contrary course, it may be rendered the sole cause of the drying quality required to be given to a fat oil. Water in the state of snow will exhibit the two conditions essentially necessary to produce this effect: extreme division of parts and multiplication of contact between the moleculæ of the oil and the oxygen gas contained in the snow. It is on this principle that the following process is founded:

Sixth Process.

When the long continued cold of winter gives to snow a pretty dry consistence, take any quantity at pleasure of linseed oil, nut oil, or oil of pinks, and mix it with snow, kneading the mixture in a bason with a wooden spatula, or in a mortar with a pestle. Form it into a solid mass, and place it in an earthen, a glass, or a porcelain vessel with a large aperture, and cover the aperture with a cloth to prevent the introduction of foreign bodies. Expose the vessel in a place accessible to the cold, but sheltered from the influence of the solar rays. On the return of a milder temperature the snow will dissolve into water, which will separate itself from the oil. If the oil has not been exceedingly clean and pure, the water is found to be charged with its impurities. If the severe temperature continues two months, as is the case during some winters, the oil will acquire in a higher degree its drying quality. A part of the oil retains then a little water, and it forms a pellicle, which in colour and consistence resembles that composition known under the name of painters' cream or butter*.

The oil is decanted from off the water, or it is removed with a spoon and put into a bottle. Rest, by separating the interposed particles of water, is sufficient to clarify it. This separation may even be accelerated by exposing the oil to the heat of a balneum mariæ.

* Painters who leave long intervals between their periods of labour are accustomed to cover the parts they have painted with a preparation which preserves the freshness of the colours, and which they can remove when they resume their work. This preparation, which is as follows, is called painters' cream:

Take Very clear nut oil 3 ounces.
Mastic in tears, pulverized, ½ ounce.
Sal Saturni in powder (acetite of lead) ⅛ of an ounce.

Dissolve the mastic in oil over a gentle fire, and pour the mixture into a marble mortar over the pounded salt of lead; stir it with a wooden pestle, and add water in small quantities till the matter assume the appearance and consistence of cream, and refuse to admit more water. I have found means to introduce 7½ ounces into this composition by whipping it with a bunch of small twigs.

The oil by this simple mixture acquires a drying property, and appears as little coloured as it was before it was subjected to this process. The circumstance, therefore, of the division of the moleculæ of the oil, which multiplies, and facilitates its contact with the oxygen gas contained in the snow, concurs in an effectual manner to produce the required result—that is to say, the disappearance of that unctuous and fat state which is one of the principal distinguishing characters of fat and essential oils.

Modification of the same Process.

If an oil already rendered drying, by one of the preceding operations, be employed in this process with as few reacting ingredients and as little heat as possible; the oil becomes drying in an eminent degree. It is then very thick, and a part of it is so confounded with the water that the result is a glutinous and almost resinous matter, which adheres so much to the interposed liquid that it obstinately retains that form, whatever process may be employed to break the union of the water and the oil. But in treating oil of hemp seed in this manner, I observed, in the course of the second operation, the separation of two very distinct oils; one of which having a greater specific gravity than water fell to the bottom of the vessel, while the other occupied the upper part in such a manner, that the whole of the liquid produced by the melting of the snow formed an intermediate stratum between these two oils.

The first, that is to say the heaviest, was very little coloured: it was less so than the second, and even than the oil of hemp seed itself was before its mixture with the snow. The first stratum of oil formed two zones, the upper one of which was clear; the other was opake and of a chamois colour. The latter, which retained water, was exceedingly thick, and as if resinified. The water which served to separate these two kinds of oil was nebulous. In general its present state depends on the greater or less purity of the oil employed, and on that of the snow.

These two varieties of oil are highly drying; and when kept for a summer, I have found great difficulty to extract them from the bottles in which they were preserved.

The heaviest oil, and that found the least coloured, may be used for the preparation of paste made with white lead or Cremnitz white, employed to repair broken enamel *.

Seventh Process.

These attempts lead to another kind of experiment, more direct, which confirms in a complete manner the theory respecting the causes of the state of inspissation, and the drying property which oils acquire by the different processes usual among artists. The results before detailed induced me to try to discover means proper for shortening the operation, by exposing oil to the influence of a current of oxygen gas. Though I had observed in my experiments on essence of turpentine exposed for a considerable time to the contact of oxy-

* On this subject see Part II.

gen gas, often renewed, that this process was not sufficient to facilitate a reciprocal combination, since the gas filtered through the stratum of oil and the mass of water covered by this oil, without adding in a sensible manner either to its state of inspissation or to its specific gravity*, I could not see in this first effect any thing to prevent similar experiments on fat oils. It was possible that the chemical difference which existed between the two kinds of oil might conduce to give new results; and it was also possible that, by directing on the oil a current of oxygen gas, accompanied with caloric, I should be able to destroy that kind of inactivity which the gas exhibited in the experiments just mentioned.

With this view I exposed nut oil, inclosed in a very narrow long tube, to a current of oxygen gas, disengaged from manganese by sulphuric acid. The orifice of the tube was arranged in such a manner as to present a certain resistance to the too speedy dispersion of the gas which escaped from the mass of oil. The absolute weight of the oil before the experiment was three ounces. After the disengagement of the gas, which continued five hours, the oil had experienced no other change than a slight modification in its colour, which was become clearer. Its weight was absolutely the same, and it retained its taste of the fruit.

I exposed the same oil, but without success, to a new mixture, the gaseous disengagement of which continued eight hours: I then hoped that the mixture or

* Journal de Physique, Mars et Avril 1798.

combination of an acid with oxygen would enable me to add a new process for giving a drying quality to oil more speedily, and for obtaining it colourless.

Eighth Process.

Muriatic acid (marine acid), which of all the mineral acids produces the least change on oils, exhibited, in its affinity for oxygen gas, that mean state of combination which seemed likely to answer the purpose I proposed. I therefore directed into a tube filled with oil a current of oxygenated muriatic acid gas, employing as much care and attention as possible in the operation. Signs of a combination instantly appeared. The colour of the oil was altered; and a brown but transparent tint soon succeeded to the beautiful lemon colour which it had retained. Its fluidity and the odour of the fruit gradually disappeared, to give place to those of baked oil. When examined by a balance, twenty-four hours after, it weighed 33 grains more. In this state it impressed on the tongue the savour of rancid oil, with a slight taste of acid exceedingly difficult to be perceived. The passage of the oxygenated acid gas had continued six hours.

The same experiment, repeated on the same oil, still deprived it of its colour. The rancid odour was more perceptible, but the weight had increased only 12 grains. The three ounces of oil then announced an addition of 45 grains, or of 15 grains per ounce.

This oil being exposed to the sun for five days, I mixed one part of it with three parts of water. The mixture, assisted by motion, formed a very thick emulsion, which by rest separated into two parts. The supernatant oil always remained white like an emulsion. Exposure to the sun, and afterwards in a balneum mariæ, did not effect a separation of the interposed water. This is a property peculiar to drying oils. Time alone overcomes all difficulties.

The water, when drawn off, scarcely produced any change in blue vegetable tincture. Concentrated liquor of carbonate of potash (alkali of potash) produced with it no effervescence.

It was now of importance to make a trial of this drying oil on delicate colours, such as the aluminous rose-coloured lakes extracted from Brasil wood. This colour, mixed up with this oil and spread over a piece of walnut-tree wood, was five days in drying; on white wood it required only two days.

The union of white lead with the lake, in order to form a dark flesh colour, required for walnut-tree wood only two days, and for white wood twenty-four hours. The colours retained their full brilliancy.

These trials might have appeared sufficient to give confidence in regard to the employment of this process, in which a very intimate union is observed between the oil and that principle which renders it drying in a very little time by the help of the acid, which serves as a medium. It is not expensive, and oil prepared in this manner will absolutely be colourless unless when that of pinks or of white poppy seeds is used. I employed, in each of these experiments, three ounces of pure pulverized magnesia, and 2½ ounces of common sulphuric acid, diluted with an ounce of water. I adapted to the retort a small intermediate receiver, placed between it and the bent tube, which was conveyed to the bottom of the cylinder containing the oil. By these means the acid emanations, which escaped from the retort, did not reach to the oil. This operation may be very well performed in a sand bath.

The continuance of three ounces of nut oil, extracted without heat, upon four ounces of water saturated in a great part with oxygenated muriatic acid, did not produce so speedy an effect. Two months elapsed before the oil had acquired the odour and consistence peculiar to drying oils. It was exceedingly limpid, and its bright lemon colour had become orange.

I shall conclude this article with some general observations on the process which communicates to fat oils those qualities by which drying oils are characterized, and on the principles of the theory respecting them.

General Observations.

Every oil is susceptible, without preparation, of composing a colour by its mixture with a colouring body, and even of constituting a durable varnish with the same colour. In this particular case, the time necessary for the desiccation of such a mixture will always be proportioned to the nature of the oil employed. The fattest and the most unctuous will also be the slowest in drying: there are some which will even require several years before they attain to the necessary consistence and solidity.

Art has found means to overcome this difficulty by certain mixtures, which modify the principles of the oils, and render them proper for a speedy renovation of the strata. It is probable that the mixture of certain oils with metallic oxides, such as litharge, ceruse, verditer, &c., the drying effect of which is very speedy, may have served as a guide to the first person who made researches in regard to colours. Every discovery produced by accident remains a long time in the hands of the author; but new trials soon multiply the results, and increase the resources of the art. Jealousy, in matters relating to the arts, views every thing with an observing eye. It creates particular compositions; and hence that variety of formulæ which art, in extending itself, either confirms or rejects.

Routine taught, in general, that to free an oil from its greasy particles, and to give it a drying quality, nothing was necessary but to bring it into contact with different substances known to be more or less effectual for that purpose, and which, by help of a well regulated fire, free it from an unctuous matter, the presence of which would communicate to colours a viscidity which would render the use of them more disagreeable, and even impossible, in consequence of its slowness to assume a body.

The effect once obtained, the first authors of such processes would proceed no further. Whether the oil by this application of certain foreign bodies received any new principle, or lost one itself, or whether it experienced only a simple modification in its substance, was to them of little importance. Satisfied with the effect, they gave themselves no trouble about the cause.

Their only aim was to render the effect certain, at the expense even of the colour of the oil, by adhering to a certain regularity in the execution of the process. This was the strict result of the experiment.

At present art goes further, by proceeding from the effect to the cause. This is accomplished by researches which conduct to theory; and theory simplifies every thing by throwing new light on what is already known, and fixes the great value attached to good descriptions of the arts.

If we consult experience in regard to the art of common house-painting, it will be seen that the substances which best answer the ends proposed in the preparation of oils are exactly those which contain the greatest quantity of oxygen (the base of pure air), and which are the most susceptible of abandoning it in favour of the oil with which they are in contact. This is the result of a real elective affinity, determined by the application of caloric, or by a kind of particular processes.

This essential condition is perfectly answered by metallic oxides. They resign to the oil the oxygen which deprives them of their metallic brilliancy, and which gives them the pulverulent form: this process is a kind of combustion. The oxide deprived of its oxygen assumes then its first metallic form. This is what is observed in the remaining matter of an oil rendered drying by litharge. The case is the same when ceruse, white lead, massicot, salts of lead, &c. are employed.

The direct influence of oxygen in the state of gas, and united to the muriatic acid, is accompanied with the same effects as I have indicated in the eighth process: in a word, the metallic salts, the acids of which are highly charged with oxygen, have the same property, but in a degree inferior to pure oxide*.

After all these effects, which result from the application of these first substances to oils, it needs excite no astonishment that oil exposed to the sun, and particularly in leaden vessels, according to Watin's manner, should in the course of time acquire a drying property. The oxygen gas, which forms part of atmospheric air, soon renders them rancid by the development of an acid principle. This effect, arising from the combination of the oxygen, would be speedier if the mixture were exposed to a higher temperature than that given to it by the sun: but in this case the principles of the oil in a state of decomposition would communicate to it a colour, which would confine the use of it to common painting.

If fat oil then be exposed in a leaden vessel in a place where it has a free communication with the exterior air, or if a glass vessel in which plates of lead are put be employed, the oxidation of the lead will be effected in both these cases by the modifications which the oil experiences, and which are necessary to render it drying. The experiment may even be varied. If glass vessels filled with oil to which a metallic oxide has been added are exposed to the sun, and if the vessels be closely shut, the result will be exactly the same, but slower. In the latter case, the metallic oxide will ap-

* See the word *Oxide*, Part II.

proach its former state by the loss of a part of the oxygen which constituted it an oxide; and this transition will take place according to the quantity of the oxygen liberated and given up to the oil. It is needless to observe, that a higher temperature than that produced by the sun would give the same results as the first processes here described. These results are always the same, but produced sooner or later according to the nature of the substances employed, and the energy of the means which constitute the process.

If we consult all the books which treat on house-painting, &c. and on the matters employed for that purpose, we are struck with the variety of the formulæ, both in regard to the doses of the re-agents and the method of using them. Some authors recommend the concurrence of water: but this is rejected by others, in consequence of the property it possesses of not being miscible with oils, and of the difficulties it presents in regard to clarification. The first quality, however, renders it proper for this use, and it has that also of acquiring, over the strongest fire, only a determinate degree of heat, because it carries off in its state of vapour the excess of caloric; the accumulation of which in the oil, treated without this medium, would not fail to become prejudicial. The process is slower; but this slowness is compensated by the state of the drying oil, which is colourless, and even pretty limpid, when the greater part of the water is evaporated towards the end by a gentle heat.

Some artists, imitating the author of *Le Parfait Vernisseur*, inclose their re-agents in a small bag; and others, after the example of Watin, mix the ingredients with the oil. The fact is, that all these methods succeed, and produce a drying oil very little coloured, if the fire has been properly managed, and if substances which might give to the oil a foreign colour be kept at a distance from these mixtures. It will, therefore, be proper to employ only metallic oxides, such as ceruse, white lead, litharge, and flowers of zinc. Some metallic salts participate to a certain degree in the same property. Of this kind are the sulphate of zinc and acetite of lead (white vitriol and salt of lead).

Watin himself, who seems to have overlooked the true theory of this operation, does not appear sufficiently nice in the choice of the matters he employs for freeing oils from their greasy particles. He indicates as an essential substance ombre earth, which in general contains a bituminous matter, that communicates to oil a foreign colour. In like manner he prescribes the use of a kind of stone, pretty rare, called Muscovy talc, with the influence of which on oil we are as yet little acquainted, and the place of which is supplied in France by a species of sulphate of lime, very common at Paris and in the neighbourhood of that city. It is known to the vulgar under the name of *miroir d'ane*.

In the preceding formulæ I have varied the doses as well as the nature of the re-agents. In this respect, however, there is a sort of rule established in some measure by a series of practical observations: that is, to extend the quantity to one-eighth of the oil employed. This quantity will be sufficient in the ordinary cases of painting, if the matters used are all of the same energy; that is to say, if they are all capable of furnishing during the operation the same quantity of acting principle—oxygen. I made a point of abstaining from substances whose influence, in this point of view, did not appear to be fully proved, and from those which would communicate to oil a foreign colour: in a word, the formulæ given in this work have all been proved by experiment.

The process most common among artists who are desirous of freeing an oil from its greasy principles, consists in communicating to it, before they add the drying ingredients, a degree of heat nearly equal to that which produces ebullition. This method would be attended with inconvenience if the whole matter were abruptly mixed, and especially if the vessel were not of a sufficient size to obviate the effects of the swelling of the oil. Ceruse and acetite of lead (salt of lead), sulphates of lime (selenites), and ombre earths, contain moisture, which expands and distends the oil. This tumefaction is so speedy that there is always some danger of its catching fire.

The previous calcination recommended for certain matters, without specifying the reason, as for ceruse and salt of lead, is to be considered here only in a practical point of view, as a mere precaution in the process. When these matters are employed without previous calcination, it will be proper not to add them to the almost boiling oil but in small separate portions.

In all cases where preparations of lead are employed for freeing oils from their greasy principles, great care must be taken not to stir the mixture too much with a spatula, because the oil then becomes charged with the lead, and, combining with it, retains it under the form of soap. The oil is thus rendered exceedingly thick, and assumes the consistence of jelly. It will be sufficient to leave the mixture to itself over a gentle fire capable of making the liquid enter into a slight degree of ebullition.

I have known painters of ornaments, and coach painters, who preferred adding sulphate of zinc (white vitriol) to their colours rather than applying it to the preparation of their oil. This method is defective. The salt refuses to incorporate with the oil. It then renders the painting mealy, and even occasions cracks in it.

The garlic, often added to preparations of this kind, is employed merely for the purpose of indicating the moment when the whole aqueous part of a mixture is evaporated: it however possesses of itself a very drying quality. The garlic alone, or the juice of garlic, employed in a proper dose would render oil exceedingly drying. It is even used in certain cases to form a ground to colours which refuse to adhere to the bodies on which they are applied.

Drying oil is employed for several purposes. When colourless it is much sought after by those who paint pictures. It enters into the composition of varnish, and it serves itself as varnish in oil painting, either employed alone, or diluted with a little essence of turpentine. When destined for house painting it will be advantageous to use, for the last coating, that to which I give the name of *resinous drying oil*, and which exhibits all the qualities of a varnish. I have often employed it for painting applied to bodies sheltered from the rain and the sun, by mixing it with the delicate colours. It is to be recommended also for strong colours, such as yellow, red, green, and in particular ochres. The preparation of it is as follows:

RESINOUS DRYING OIL.

Take 10 pounds of drying nut oil if the paint is destined for external articles, or 10 pounds of drying linseed oil if for internal.
Resin 3 pounds.
Turpentine 6 ounces.

Remarks.

Cause the resin to dissolve in the oil by means of a gentle heat. When dissolved and incorporated with the oil, add the turpentine: leave the varnish at rest, by which means it will often deposit portions of resin and other impurities; and then preserve it in wide-mouthed bottles. It must be used fresh: when suffered to grow old it abandons some of its resin. If this resinous oil assumes too much consistence, dilute it with a little essence, if intended for articles sheltered from the sun, or with oil of pinks.

In my country, where the principal part of the mason work consists of stones subject to crumble to pieces, it is often found necessary to give them a coating of oil paint to stop the effects of this decomposition. This painting has a great deal of lustre, and when the last coating is applied with resinous oil it has the effect of a varnish. To give it more durability the first ought to be applied exceedingly warm, and with plain oil or oil very little charged with the gray colour, which is added to the two following.

In general, every first coating with oil applied to a wall, ceiling, &c. ought to be exceedingly warm, to harden the surface which is to receive the painting.

DRYING OIL FOR PRINTERS' INK.

Printers' ink is a real black paint, composed of lamp black and linseed oil, which has undergone a degree of baking superior to that of the different drying oils already mentioned. A greater or less consistence is given to it, according to the strength of the paper; and this depends on the degree of baking given to the oil, or on the mixture of a greater or less dose of lamp black.

The degree of heat applied to the oil is sufficiently great to decompose it in part, and even to make it inflame. Should this prepared oil retain unctuosity, it would fill the eye of the letter, run upon the paper, and communicate to it a semi-transparency of a yellow colour. This effect is particularly striking in works printed with bad ink.

The preparation of this ink is simple: Boil linseed oil for eight hours in a large iron pot, and add to it bits of toasted bread, for the purpose, no doubt, of absorbing the water contained in the oil. Leave it at rest till next morning, and then expose it eight hours more to the same degree of heat, or until it has acquired the necessary consistence: then add lamp black worked up with a mixture of essence of turpentine and turpentine.

This operation is to be performed in the open air, to prevent the bad effects of the vapour of the burnt oil, and, in particular, to guard against accidents by fire.

This process deserves a place here, because it forms a part of those employed for giving oils a drying quality, and as the result of it is real oil painting; but, being foreign to the art of the varnisher, it is not necessary to make any further observations on this subject.

CHAPTER III.

General observations on varnishes; with a distribution of them into five genera, determined by their nature and state of consistence.

THE word *varnish* is a general expression used to denote every dry or liquid substance, the extension of which over solid bodies gives to the surfaces of them a certain lustre by a combined effect of the reflection and refraction of the rays of light. Confining our view to this single effect, there are many substances which may be confounded with those that appear to us to possess all the essential qualities necessary for producing this lustre in a permanent manner. Thus water, oil, and indeed every fluid, spread over the surface of polished wood, soon changes its appearance, and gives it a certain lustre, which must not be confounded with that resulting from the application of a real varnish, because this effect is not permanent.

The case is not the same with pure gums, such as that of the cherry tree, plum tree, &c. and in particular gum arabic, when diluted with a certain quantity of water. These substances form real varnish, the effect of which is permanent, and which is sometimes employed with success to preserve from alteration certain porous bodies, such as eggs; and to heighten in other bodies the splendour of their natural colours, as is the case in regard to shells. The same end is accomplished under the hand of the naturalist by albumen (the white of an egg) diluted with a little brandy. It is the same substance also which gives a lustre to that kind of varnish with which boots and shoes are covered. In the last place, gelatin (animal jelly) diluted with water participates in the same properties. In a word, every liquid, transparent substance which deviates from the simplicity of the composition of water; which is susceptible of uniform extension over a solid body; which does not suffer itself to be entirely dissipated; and which, in evaporating in part, leaves on the body it covered some traces of its presence, exhibits the phænomena of a varnish, and approaches more or less to the qualities of real varnish.

In consequence of these reasons I might have been induced to form varnishes of this kind into a particular class, had I not been prevented by considering that the art of the varnisher can dispense with this supplement. I shall yield to the same motive in regard to stony and saline substances, which by means of certain processes and the assistance of heat are converted into a kind of glazing, which has been ingeniously applied to the decoration of the fine kinds of pottery—a branch of industry that maintains so many manufactories of earthen-ware and porcelain. These, however, are real varnishes; and in the arts are known only under that technical appellation. The art, then, the processes of which I mean here to examine and describe, is confined to the composition and use of the varnishes resulting from a solution of resinous or gummo-resinous substances in different spirituous or oily liquids, according to the consistence required to be given to the varnishes, and the use to which they are destined.

Confined within these limits, the art of the varnisher consists in discovering and applying to practice certain formulæ of composition; and in endeavouring to unite the essential qualities which constitute good varnish; namely, lustre, transparency, and durability. The last quality is the most difficult to be obtained.

From the knowledge acquired respecting the nature of the substances capable of being employed in the composition of varnish, one might be induced to believe, that if the application of it to objects of luxury be of a modern date, the invention of it may be traced back to that antient period when the art of healing acquired its formulæ. The apothecary was obliged, in consequence of his profession, to make frequent solutions of resinous substances in spirituous vehicles. These solutions, known under the name of *tinctures*, were so many kinds of varnish, which to become really so required only to be applied to objects different from those for which they were intended. It is probable that the period of their application to the purposes of luxury is not much later than that when the Jesuit missionaries made known, on their return from China, the beautiful lacquered wares of that country. The chemists, who found in these beautiful specimens objects of comparison, exerted themselves to discover the means of imitating these compositions by substances with which they were familiar. It may be readily conceived, from this short view, that every resinous or gummo-resinous solution in a proper fluid, susceptible of depositing by evaporation the substance it is charged with, and of making it appear under the form of a transparent lamina, brilliant and more or less solid, constitutes what in the language of the arts is called varnish.

PARTS OF WHICH THE ART OF THE VARNISHER IS COMPOSED.

The art of the varnisher comprehends three essential parts:

1st, Composition.
2d, Application.
3d, Polishing.

FIRST PART.

Composition.

This part is confined to resinous, inflammable substances, which have a certain analogy to some spirituous liquors, in consequence of which they are disposed to unite with them mechanically, by that kind of affinity which the integrant moleculæ of resinous bodies, and those of the fluid that serves them as a vehicle, exercise on each other.

In consequence of these conditions, established on the analogy and homogeneity of the substances employed, it may be readily conceived that this part must be confined to a certain number of resinous bodies and oily substances, the composition of which approaches very near to, and is often identically the same as, that of resins. Thus all essential oils, the spontaneous or forced evaporation of which leaves a resinous residuum, exercise on resins, which are only dried essential oils, a kind of affinity, founded on this homogeneity of principles, and on this necessary analogy.

In all cases, the solution of resins seems to take place in the inverse ratio of the quantity of the essential water, or that which enters as a principle into the composition of the vehicle employed. Sometimes, however, the solution depends so much on a particular state of composition, that it forms an exception to this kind of rule. A vehicle is often employed, the composition of which deviates so much from the nature of essential oils, that water seems to be one of its predominant principles. This difference, however, does not constitute a character which ought to make it be rejected; since, on the contrary, water is considered as one of the principal agents in the composition of varnish, when applied to resins, the choice of which has been determined by experiment: of this kind is alcohol (spirit of wine).

But on the one hand, if varnishes formed with alcohol seem to be those most endowed with a drying quality, as well as the most brilliant, and the least disagreeable to the sensation of smell; and if they are the least liable to communicate a foreign colour to the grounds on which they are applied; they are, on the other, destitute of that consistence and solidity which are justly considered as the most essential qualities of varnish, the excipient of which is of an oily nature.

The observation of these differences has induced artists to confine themselves, in the employment of varnish, within certain bounds. None of the compositions known are indiscriminately proper for all purposes; because a certain concordance ought to exist between the varnish and the article to the decoration of which it is intended to contribute. The varnisher finds it sometimes convenient to retard the desiccation of his composition, that proper time may be left to the designer to delineate and even to detail his subjects. In other cases, he endeavours to give to the bodies which he covers with his compositions a solidity capable of opposing a certain resistance to shocks and to friction.

These circumstances, which are well known to all persons acquainted with the details of this art, render it necessary to have compositions of various kinds, which it will be proper to treat of separately. The method of classing objects, according to their essential properties, has appeared to us that best suited to the present case. We shall, therefore, apply it to the distribution of varnishes, being persuaded that it will facilitate researches respecting the different kinds of varnish, and the varied cases of their application.

SECOND AND THIRD PART.

Application and polishing.

The two other parts which constitute the art of the varnisher relate more directly to the artist than to the amateur. They require more experience than study. The application and polishing of varnish require practice. The precepts, however, which are applied to this part, present no difficulty which may not be surmounted by an intelligent and skilful amateur. It is the mechanical part of the art; and it deserves observations which will be introduced when we come to treat of the use of varnishes, and of colours, and of the means established by art for giving to the whole the necessary beauty and splendour.

Recapitulation.

Every resinous substance, soluble in alcohol (spirit of wine), forms a varnish fit to be employed if the resin be of such a nature as to have no decided influence on the colour of the liquid. Resinous substances of a soft and viscid consistence, such as turpentine, Canadian balsam, that of Judea, &c.; dry resins, such as mastic and sandarac; soft resins, such as galbanum in tears, gum elemi, gum anima, &c. are susceptible of forming varnishes, by dissolving wholly or in part in alcohol. In like manner, all essential oils, as well as expressed oils, when they have been subjected to those preliminary preparations which give them a drying quality, form varnishes, when they keep resins, gummo-resins, or balsams, in a state of solution.

The composition of varnish depends then on the property of solubility, in which several substances participate, but with modifications depending on their particular nature. These substances, however, when thus united, exhibit mixed properties, much superior to those they possess individually, and which concur to produce results that are sought for in the common kinds of varnish; that is to say, speedy desiccation, lustre, and solidity.

However apparent the different points of relation which seem to exist between the principles that constitute resins, it may readily be perceived that their identity is not completely established. They exhibit in their texture and in their physical properties differences very striking. They cannot, therefore, all present the same phænomena, when treated separately. The necessity of the mixtures which constitute the common formulæ has soon been perceived; and it is on these mixtures that the variety of the compositions, and of their results, is founded. Certain varnishes possess a drying quality in an eminent degree: these are the least durable. Others are glutinous, fat, and long in drying; but these are the strongest when they have attained to the proper degree of desiccation. Some hold an intermediate rank between these two kinds; they have therefore a mean quality between those varnishes the most exposed to accidents, and those which present the greatest resistance to the impressions and friction of hard bodies.

A careful observation of these differences could not but induce the authors who have written on the art of varnishing, to distinguish them by the help of a classification, founded on the nature of their composition, and on the uses for which they are destined.

I have thought it my duty to follow the same order. It has the advantage of exhibiting each varnish surrounded, in some measure, by its particular properties, and of enabling artists to refer known compositions, and such as may afterwards be invented, to one of the genera or species determined by the order and nature of their component parts. This division also indicates the case in which they may be employed, and the mode of using them.

DIVISION OF VARNISHES.

Two classes of varnish, divided into genera and subdivided into species, may be admitted in this work. The first class comprehends the varnishes used for objects of natural history, the genera of which are borrowed from that of the substances employed, and which may belong to the vegetable kingdom, as the solution of a pure gum; or to the animal kingdom, such as gelatin (the gelatinous part or jelly), extracted from different parts of animals. I have already spoken of those kinds of varnish which are employed under some particular circumstances, and which depend more on art by their effects than by the state of their composition.

The second class, which is the principal object of this work, ought to comprehend, and indeed does so, the varnishes resulting from the solution of one or more resinous substances in a spirituous or oily vehicle. It will be exceedingly convenient to divide it into five genera, each of which has its proper species. These genera and species depend on the essential quality of the varnishes; on the state of their consistence; and on their drying quality, more or less striking.

The first genus comprehends the most drying varnishes that can be obtained with alcohol (spirit of wine).

The second genus presents formulæ for varnish nearly similar to those of the first; but they are of a less drying nature, in consequence of the addition of less drying resins. This second genus gives different species of mutative or changing varnish, which do not require so much solidity as those destined for glazing metallic surfaces.

The third genus is reserved for compositions in which the nature of the excipient is changed. Alcohol here gives place to essential oils, and in particular to essence of turpentine. This class ought to comprehend changing varnishes, and those distinguished by the name of *mordants*.

The fourth genus is destined for the employment of pure copal treated with essence of turpentine, and even with ether. These varnishes vie, in point of solidity, with those of the following genus, and ought even to be preferred to them.

The fifth genus admits of fat drying oils being employed as the excipient. It contains the fat varnishes made with copal, with amber, and with caoutchouc. Their colour, which is pretty dark, confines the use of them to grounds of a dark colour.

Each composition will be accompanied with particular remarks, relating to the process; to the nature and qualities of the varnish; and to the circumstances most favourable for its application. This new arrangement appears to be the more convenient, as it will better enable the artist to make use of the subjoined observations, than if they were united into one body and separated from the formulæ.

FIRST GENUS.

DRYING VARNISHES MADE WITH ALCOHOL (SPIRIT OF WINE).

First species.

No. I.

Take Pure alcohol 32 ounces.
Purified mastic 6 ounces.
Gum sandarac 3 ounces.
Very clear Venice turpentine 3 ounces.
Glass coarsely pounded 4 ounces.

Remarks.

Reduce the mastic and sandarac to fine powder; mix this powder with white glass, from which the finest parts have been separated by means of a hair sieve; put all the ingredients with alcohol into a short-necked matrass, and adapt to it a stick of white wood, round at the end, and of a length proportioned to the height of the matrass, that it may be put in motion. Expose the matrass in a vessel filled with water, made at first a little warm, and which must afterwards be maintained in a state of ebullition for one or two hours. The matrass may be made fast to a ring of straw.

The first impression of the caloric (heat) tends to unite the resins into a mass: this union is opposed by keeping the matters in a state of rotary motion, which is easily effected by means of the stick, without stirring the matrass. When the solution seems to be sufficiently extended, add the turpentine, which must be kept separately in a phial or a pot, and which must be melted, by immersing it for a moment in a balneum mariæ. The matrass must be still left in the water for half an hour, at the end of which it is taken off; and the varnish is continually stirred till it is somewhat cool. Next day it is to be drawn off, and filtered through cotton. By these means it will become exceedingly limpid. This simple process is sufficient for the composition of all those species of varnishes which will form part of the first four genera, unless it is necessary to operate on a large scale. Many amateurs are satisfied with simple digestion for such varnishes, taking care to stir often the mixture. This method, which may be proper for varnish composed with alcohol, would be too slow for varnishes of the third and fourth genera. In general the digestion is terminated by some hours' exposure to the sun. This second exposure approaches very near to the use of a balneum mariæ; and, like it, requires the precaution of renewing the surfaces by stirring the sediment with a clean rod.

The addition of glass in this case may appear extraordinary; but experience induces me to recommend the use of it. This substance divides the parts of the mixture which has been made with the dry ingredients, and it retains the same quality when placed over the fire. It therefore obviates with success two inconveniences, which are exceedingly troublesome to those who compose varnishes. In the first place, by dividing the matters, it facilitates the action of the alcohol; and in the second its weight, which surpasses that of resins, prevents these resins from adhering to the bottom of the matrass, and also the coloration acquired by the varnish when a sand bath is employed, as is commonly the case.

I have observed that the best alcohol can never become charged with more than a third of its weight of the resinous substances subjected to its action. The particular examination I have made of several kinds of varnish, the consistence of which was proper, never indicated a greater increase of weight than a fourth part of the primitive absolute weight of the alcohol employed. In this respect I was struck with the large doses which the best authors employ in several of their formulæ. There are some resins, indeed, so difficult of solution, that they suffer very little of their substance to be attacked; and therefore the doses of them may be increased when they are mixed with other resins. But these particular cases may be known. There arises, therefore, a loss of resin, which ought to be prevented by corrections which I shall here propose, and which I have always followed.

It would be forming a wrong idea respecting the nature of the resins which appear to be properest for solution in alcohol, were we to believe that they dissolve entirely in that fluid when employed in high doses. One may be easily convinced, by a series of very simple trials, that these substances are composed of moleculæ, the chemical properties of which vary in regard to their degree of solubility. They ought to be considered as composed of parts exceedingly soluble in a low temperature, and even on their simple contact with alcohol; of other parts somewhat less soluble, and which require to be assisted by a little heat; and of others on which the impression of the air, of the sun, and even of the heat of infusion, has effected a modification, which is perceived by the resistance they offer to the action of the spirituous liquid. These three parts, however, constitute in the resin a homogeneous whole; and nothing but the process of solution, and its results, can make them be observed under their real characters. But whatever may be the quantity of the liquid added to the resinous residuum, with a view to obtain a complete solution, the effect will not answer expectation.

When too large a dose of matter, therefore, is added to alcohol, the latter seizes on the most soluble parts, and has very little effect upon those which are less so. The dry parts of the resin escape the action of the liquid if only a moderate heat be employed, as is here practised. In this case the varnish has very little colour; but if it seems to gain in pliability, it loses in point of consistence and solidity. It is of great advantage to unite all these three characters at the same time; and this may be accomplished by limited doses, and by employing a little more time and pains in the process.

The process of making varnish may be reduced to simple trials; or, if conducted on a large scale, is subordinate to general precepts, a view of which will be found in the following chapter.

The varnishes which constitute the first genus are employed for the most part to supply the place of glazing. They are brilliant, but do not all possess the same degree of solidity. The first species exhibit more pliability than consistence or body. The application of them seems suited to articles belonging to the toilette, such as dressing-boxes, cut-paper works, &c. The next species possess the same brilliancy and lustre; but they have more solidity, and are exceedingly drying.

Second species of varnish of the same genus.

No. II.

Take Pounded copal of an amber colour, once liquefied according to my method, 3 ounces.
Gum sandarac 6 ounces.
Mastic cleaned 3 ounces.
Clear turpentine 2½ ounces.
Pounded glass 4 ounces.
Pure alcohol 32 ounces.

Mix these ingredients, and pursue the same method as that indicated for No. I.

Remarks.

The opinion generally entertained of the insolubility of copal in alcohol might have inspired me with some doubt in regard to the employment of this matter. I might even have dreaded that criticism which has not spared the authors of the *Parfait Vernisseur* and of the *Dictionnaire des Arts*, &c.; but I can assert that the mixture I have here indicated will give a varnish much more durable than if no copal had been employed.

The great division of this substance obtained by grinding it on porphyry, and by its mixture with other resins, favours the action of the alcohol over it; and the parts detached from it are sufficient to give to this varnish a character of solidity very remarkable, and which it would not have possessed in the same degree without copal.

If you are desirous to facilitate the solution of a greater quantity of copal, you may add to this formula three gros of camphor; but this dose must not be exceeded.

The case already mentioned in regard to an overcharge of dry matters, when there are any which resist, in part, the action of the vehicle presented to them, is here exemplified. If the copal were entirely suppressed, the alcohol would still find a sufficient quantity of matters to form the varnish.

Uses.

This varnish is destined for articles subject to friction, such as furniture, chairs, fan-sticks, mouldings, &c. and even metals, to which it may be applied with success. The sandarac gives it great durability.

First species of varnish of the same genus, destined for the same articles as No. II.

No. III.

Take Gum sandarac 8 ounces.
Pounded mastic 2 ounces.
Clear turpentine 4 ounces.
Pounded glass 4 ounces.
Alcohol 32 ounces.

Remarks.

The formula for this varnish is extracted from Watin's work. The dose of the turpentine appears to me to be rather too large; because it diffuses through the varnish a viscous matter, which renders it long in drying. Besides, it communicates to it a strong smell, which to many persons is exceedingly disagreeable. This formula authorizes an observation which may be applied to many other cases: when a substance, which by its nature and consistence is exceedingly soluble, is subjected to the action of a pound of alcohol, it precipitates in part the other dry substances which do not possess the same degree of solubility. A kind of resinous crystallization which covers the bottom of the vessel then takes place, if the mixture be left at rest. This consideration alone would induce me to suppress, in this formula, the half of the turpentine.

SECOND GENUS OF VARNISHES.

ALCOHOLIC VARNISHES LESS DRYING THAN THE FORMER, AND HAVING A WEAKER SMELL.

First species for cut-paper works, dressing-boxes, and other articles of the like kind, &c.

No. IV.

Take Gum sandarac 6 ounces.
Gum elemi 4 ounces.
Gum anima 1 ounce.
Camphor ½ ounce.
Pounded glass 4 ounces.
Pure alcohol 32 ounces.

Make the varnish according to the prescription already indicated. The soft resins must be pounded with the dry bodies. The camphor is to be added in pieces.

Remarks.

These varnishes of the second genus admit modifications in the nature of the substances which concur towards their formation. They are not so dry as those of the first genus. They give pliability, brilliancy, and solidity to the compositions, without injuring their drying quality.

Second species of the same genus, destined for the same purposes.

No. V.

Take Gallipot or white incense 6 ounces.
Gum anima } of each 2 ounces.
Gum elemi }
Pounded glass 4 ounces.
Alcohol 32 ounces.

Make the varnish with the precautions indicated for No. I.

Remarks.

Varnishes composed according to the last two formulæ may be employed for the same purposes as those which form the first genus. They are much fitter, however, for ceilings and waintscoting, coloured or not coloured: they may even be employed as a covering to parts painted with strong water colours.

Third species of the same genus, for wainscoting, small articles of furniture, balustrades, and railing in the inside of a house.

No. VI.

Take Gum sandarac 6 ounces.
Shell lac 2 ounces.
Colophonium or resin, White glass pounded, Clear turpentine - - } of each 4 ounces.
Pure alcohol 32 ounces.

Make the varnish according to the directions given for No. I.

Remarks.

Watin prescribes eight ounces of sandarac and six ounces of turpentine. This dose appears to me too strong, as it is not proportioned to that of the alcohol, which in my formula finds more matter than it can take up.

This varnish is sufficiently durable to be applied to articles destined to daily and continual use. Varnishes composed with copal ought, however, in these cases, to be preferred. There is another composition which, without forming part of the compound varnishes, is employed with success for giving a polish and lustre to furniture made of wood: wax forms the basis of it.

Many cabinet-makers are contented with waxing common furniture, such as tables, chests of drawers, &c. This covering, by means of repeated friction, soon acquires a polish and transparency which resemble those of varnish. Waxing seems to possess qualities peculiar to itself; but, like varnish, it is attended with its inconveniences as well as advantages.

Varnish supplies better the part of glazing; it gives a lustre to the wood which it covers, and heightens the colours of that destined, in particular, for delicate articles. These real and valuable advantages are counterbalanced by its want of consistence: it yields too easily to the shrinking or swelling of the wood, and rises in scales, or splits, on being exposed to the slightest shock. These accidents can be repaired only by new strata of varnish, which render application to the varnisher necessary, and occasion trouble and expense.

Waxing stands shocks; but it does not possess in the same degree as varnish the property of giving lustre to the bodies on which it is applied, and of heightening their tints. The lustre it communicates is dull; but this inconvenience is compensated by the facility with which any accidents that may have altered its polish can be repaired by rubbing it with a piece of fine cork. There are some circumstances, therefore, under which the application of wax ought to be preferred to that of varnish. This seems to be the case in particular with tables of walnut-tree wood exposed to daily use, chairs, mouldings, and for all small articles subject to constant employment.

But as it is of importance to make the stratum of wax as thin as possible, in order that the veins of the wood may be more apparent, I flatter myself that the following process, which I received from one of my countrymen very expert in the art of making the articles alluded to, will be acceptable to my readers.

Melt over a moderate fire, in a very clean vessel, two ounces of white or yellow wax; and, when liquefied, add four ounces of good essence of turpentine. Stir the whole until it is entirely cool, and the result will be a kind of pommade fit for waxing furniture, and which must be rubbed over them according to the usual method. The essence of turpentine is soon dissipated; but the wax, which by its mixture is reduced to a state of very great division, may be extended with more ease, and in a more uniform manner. The essence soon penetrates the pores of the wood, calls forth the colour of it, causes the wax to adhere better, and the lustre which thence results is equal to that of varnish, without having any of its inconveniences.

Fourth species of the same genus. Varnish slightly coloured for violins and other stringed instruments, and even for furniture of plum-tree wood, mahogany, and rose wood.

No. VII.

Take Gum sandarac 4 ounces.
Seed lac 2 ounces.
Mastic - - - } of each 1 ounce.
Benjamin in tears }
Pounded glass 4 ounces.
Venice turpentine 2 ounces.
Pure alcohol 32 ounces.

The gum sandarac and lac render this varnish durable: it may be coloured with a little saffron or dragon's blood.

Fifth species of the same genus, which the turners of St. Claude employ for boxes made of box-wood, of the roots of trees, &c.

No. VIII.

Take Seed lac 5 ounces.
Gum sandarac 2 ounces.
Gum elemi $1\frac{1}{2}$ ounce.
Venice turpentine 2 ounces.
Pounded glass 5 ounces.
Pure alcohol 24 ounces.

Remarks.

The artists of St. Claude do not all employ this formula, which required to be corrected on account of its too great dryness, which is here lessened by the turpentine and gum elemi. This composition is secured from cracking, which disfigures these boxes after they have been used for some months.

Other turners employ the gum lac united to a little elemi, and turpentine digested for some months in pure alcohol exposed to the sun. If this method be followed, it will be proper to substitute for the sandarac the same quantity of gum lac reduced to powder, and not to add the turpentine to the alcohol, which ought to be exceedingly pure, till towards the end of the infusion.

Solar infusion requires care and attention. Vessels of a sufficient size to allow the spirituous vapours to circulate freely ought to be employed, because it is necessary that the vessel should be closely shut. Without this precaution the spirits would become weakened, and abandon the resin which they laid hold of during the first days of exposure. This perfect obturation will not admit of the vessels being too full.

In general, the varnishes applied to articles which may be put into the lathe acquire a great deal of brilliancy by polishing. A piece of woollen cloth is sufficient for the operation. If turpentine predominates too much in these compositions the polish does not retain its lustre, because the heat of the hands is capable of softening the surface of the varnish, and in this state it readily tarnishes.

Sixth species of the same genus, for giving a gold tint to articles of brass.

No. IX.

Take Seed lac 6 ounces.
Amber or copal ground on porphyry 2 ounces.
Dragon's blood 40 grains.
Extract of red sandal wood obtained by water 30 grains.
Oriental saffron 36 grains.
Pounded glass 4 ounces.
Very pure alcohol 40 ounces.

Remarks.

To apply this varnish to articles or ornaments of brass, expose them to a gentle heat, and dip them into the varnish. Two or three coatings may be applied in this manner if necessary. The varnish is durable, and has a beautiful colour. Articles varnished in this manner may be cleaned with water and a bit of dry rag.

Seventh species of the same genus. Changing varnish, or varnish destined to change or to modify the colour of those bodies to which it is applied.

No. X.

Take Gum guttæ $\frac{3}{4}$ of an ounce.
Gum sandarac } each 2 ounces.
Gum elemi - - }
Dragon's blood of the best quality 1 ounce.
Seed lac 1 ounce.
Terra merita $\frac{3}{4}$ of an ounce.
Oriental saffron 12 grains.
Pounded glass 3 ounces.
Pure alcohol 20 ounces.

Remarks.

The tincture of saffron and of terra merita is first obtained by infusing them in alcohol for twenty-four hours, or exposing them to the heat of the sun in summer. The tincture must be strained through a piece of clean linen cloth, and ought to be strongly squeezed. This tincture is poured over the dragon's blood, the gum elemi, the seed lac, and the gum guttæ, all pounded and mixed with the glass. The varnish is then made according to the directions already given.

It may be applied with great advantage to philosophical instruments: the use of it might be extended also to various cast or moulded articles with which furniture is ornamented.

If the dragon's blood be of the first quality, it may give too high a colour; in this case the dose may be lessened at pleasure, as well as that of the other colouring matters.

It is with a similar kind of varnish that the artists of Geneva give a golden orange colour to the small nails employed to ornament watch-cases; but they keep the process very secret. A beautiful bright colour might be easily communicated to this mixture; but they prefer the orange colour produced by certain compositions, the preparation of which has no relation to that of varnish, and which I have successfully imitated with saline mixtures, in which orpiment is a principal ingredient. The nails are heated before they are immersed in the varnish; and they are then spread out on sheets of dry paper.

Eighth species of the same genus. Changing varnish which may be employed to give a gold colour to watch-cases, watch-keys, and other articles made of brass.

No. XI.

Take Seed lac 6 ounces.

Amber - - } of each 2 ounces.
Gum guttæ }

Extract of red sandal wood in water 24 grains.

Dragon's blood 60 grains.

Oriental saffron 36 grains.

Pounded glass 4 ounces.

Pure alcohol 36 ounces.

Remarks.

Grind the amber, the gum lac, gum guttæ, and dragon's blood on a piece of porphyry: then mix them with the pounded glass, and add the alcohol, after forming with it an infusion of the saffron and an extract of the sandal wood. The varnish must then be completed as before. The metal articles destined to be covered by this varnish are heated, and those which will admit of it are immersed in packets.

The tint of the varnish may be varied by modifying the doses of the colouring substances.

The use of alcoholic varnishes will long be preferred to that of the varnishes which form the third and fourth genera; which, however, are far superior in all cases where it is necessary to add durability to the other qualities required. A comparison, which may be easily made in regard to articles subject to constant employment, will one day support theory and experience, and rectify the public opinion on this subject.

The varnishes of these first two genera can bear polishing as well as the hardest compositions which constitute the three other genera: but as they are more delicate, they admit modifications in the operation. It is never begun with pumice stone.

The most of these varnishes are destined for covering preliminary preparations which have a certain degree of lustre. They consist of cement, coloured or not coloured, charged with landskips and figures cut out in paper, which produce an effect under the transparent varnish: most of the dressing-boxes, and other small articles of the same kind, are covered with this particular composition, which, in general, consists of three or four coatings of Spanish white pounded in water, and mixed up with parchment glue. This first coating is smoothed with pumice stone, and then polished with a piece of new linen and water. The coating in this state is fit to receive the destined colour, after it has been ground with water and mixed with parchment glue diluted with water. The cut figures with which it is to be embellished are then applied, and a coating of gum or fish glue is spread over them, to prevent the varnish from penetrating to the preparation, and from spoiling the figures. The operation is finished by applying three or four coatings of varnish, which when dry are polished with tripoli and water, by means of a piece of cloth. A lustre is then given to the surface with starch and a bit of doe skin, or very soft cloth. I shall resume this subject when I come to treat of polishing.

THIRD GENUS OF VARNISHES.

Particular observations.

The varnishes which compose the third genus are less exposed to the alterations to which those that form the first two genera are sometimes subject. The nature of the excipient is here different: essence of turpentine is substituted in the place of alcohol; and this substance exhibits itself under different degrees of concentration. Almost all the resinous substances, and even the colouring substances, hitherto employed, are familiar to this third genus, and by their various mixtures with the essence may concur to accomplish the same views, and produce the same results.

It must not however be believed, notwithstanding what has been here said, that the properties of alcohol and those of essence, considered as capable to effect solutions, essential to the coloration of varnishes, are identical; they differ in many respects. Alcohol becomes charged with some particular substances which are refractory to essence: of this kind are certain colouring matters, such as indigo, turnsole, red sandal wood, saffron, &c. On these essence of turpentine produces no effect. In like manner, also, essence under certain circumstances exerts all the energy of solution on copal, which resists alcohol unless it be divided by a soluble body. At any rate, what it would separate without an intermediate substance would not be sufficient to constitute a varnish.

These differences in the chemical properties of these two liquors are not the only ones which might be adduced to justify the admission of this third genus. A consideration of no less importance may be added, namely, the superiority of varnishes made with essence to those composed with alcohol. The former unite pliableness and smoothness to brilliancy and durability: they yield better to the operation of polishing, and are less liable to crack than alcoholic varnishes. All these qualities, which are well known, ought to induce artists to prefer this genus in all cases where the preservation of the articles to which they are applied is an object of importance. This preference is necessary, in particular, for valuable paintings.

In alcoholic varnishes the deposit of the resinous matter, divided and in a state of complete solution, is sooner formed, according as the season, or circumstances arising from an artificial temperature, accelerate the evaporation of the dividing fluid. The nature of this fluid is sufficiently known; and it gives no reason to suspect that any of its parts incorporate with the resinous moleculæ, the precipitation of which confirms the effect of a varnish: the alcohol then evaporates entirely.

The case is not the same with essence of turpentine, even the most ethereous, nor with other liquids which have all the characters of oils. They are not susceptible of entire evaporation. These liquids form with resins a union the more intimate, as they add to their division by the interposition of their own substance. The less oils are light or volatile, the greater therefore will be the solidity of the varnishes resulting from their mixture with resins, and *vice versa*. The state of dryness observed in certain resinous bodies, and which is communicated to the varnishes, resulting from their union with alcohol, is then compensated and corrected in the case of their solution in an oily fluid, which envelops them in a fixed viscous and yet drying substance.

Essence of turpentine, and oils of a greater density, which are still better, would alone form varnishes by a continued succession in the application of coatings. Alcohol in this case would disappear without leaving any trace of its presence.

The consistence which varnishes acquire from essence is often increased by that arising from the particular nature of the matters which form part of the changing varnishes, and particularly of that of the varnishes distinguished by the name of *mordants*. In giving the formulæ for varnishes of this third kind, I shall follow the order indicated by the degree of their tenacity, and of their resistance to desiccation.

First species of varnish for valuable paintings.

No. XII.

Take Mastic cleaned and washed 12 ounces.
Pure turpentine 1½ ounce.
Camphor ½ ounce.
White glass pounded 5 ounces.
Ethereous essence of turpentine 36 ounces.

Make the varnish according to the method indicated for No. I. of the first genus. The camphor is employed in pieces, and the turpentine is added when the solution of the resin is completed. But if the varnish is to be applied to old paintings, or paintings which have been already varnished, the turpentine may be suppressed, as this ingredient is here recommended only in cases of a first application to new paintings, and just freed from white of egg varnish.

The ethereous essence recommended for varnish is that distilled slowly, and without any intermediate substance, according to the second process given for its rectification.

Remarks.

The question proposed by able masters respecting the kind of varnish proper to be employed for paintings has never yet been determined. Every artist has his prejudices, strengthened by example or usage, and he maintains them by specious arguments. The value, however, which ought to be attached to the works of great masters, requires stability of opinion in regard to the choice of varnish which tends to embellish and preserve works of genius.

The varnish destined for this use ought to be colourless, if possible, that it may communicate no foreign tint to the tones of the painting; it ought to unite pliability and smoothness to the most perfect transparency, in order to nourish the colours and the canvas. It must not, however, have too much glazing, as the reflection of the light is injurious to the effect.

Alcohol renders varnishes too dry for paintings, as they split and crack. Varnishes composed with essential oils, which have too much body, give too great thickness to the coating, so that they cover, or impede the effect of the colours. But in choosing varnishes of this sort one of the most requisite qualities is, that the composition should be very simple, and of such a nature as not to resist the means employed, when it is necessary to substitute a new coating in the room of old varnish.

These considerations have induced some artists to pay particular attention to this object; but they all make a mystery of the means they employ to obtain the desired effect. The real end may be accomplished by giving to the varnish, destined for painting, pliability and softness, without being too solicitous in regard to what may add to its consistence or its solidity. The latter quality is particularly requisite in varnishes which are to be applied to articles much exposed to friction, such as boxes, furniture, &c.

The following formula I have employed for thirty years; and the varnish resulting from it has been applied with success to paintings in the most valuable collections *.

* As every thing that relates to the preservation or repairing of paintings is of great importance to artists and amateurs, the following observations on this subject will perhaps not be unacceptable to the reader:

The variety of varnishes, often destructive, which are applied to paintings, occasions some complication in the means employed to remove them in order to substitute others in their place.

A new painting has often no other covering than white of egg. This varnish is of the simplest kind: it consists only of two or three ounces of weak alcohol (brandy), in which a gros or one eighth of an ounce of sugar, and the white of an egg, has been dissolved. The white of egg, with the sugar reduced to the state of powder, is beat up with the alcohol, and the varnish is then applied with a very soft sponge to the picture, placed in a horizontal position. This varnish, if a few drops of the juice of garlic be mixed with it, or if the vessel in which the white of egg is beat up be only rubbed with it, will preserve the painting from being dirtied by flies.

When it is necessary to remove this coating, the process employed is as simple as that for the preparation of the varnish. A sponge moistened with warm water is drawn over the surface of the picture with a slight degree of pressure. A kind of froth is then formed, which must be washed off with water; and this operation is repeated till no more froth appear. This method is sufficient to remove not only white of egg varnish, but also that made with gum arabic, fish glue, or any other matter soluble in water. There is no reason to be under any apprehension for the

Second species of varnish of the same genus, for grinding colours.

No. XIII.

Take New gallipot or white incense 4 ounces.
Mastic 2 ounces.
Venice turpentine 6 ounces.
Pounded glass 4 ounces.
Essence of turpentine 32 ounces.

colours; because the water has no action on the oil with which the colours have been mixed.

Great masters rarely varnish their pictures after they are finished: they protect their tints by a coating of white of egg, and do not varnish them till a year after, when the colours are completely dry. The method here described for removing this coating requires care and attention. The picture is left to dry, and the varnish is applied with precautions which are well known to all real artists.

More difficulty occurs in regard to old paintings. Besides varnishes on which alcohol and oil produce no effect, they are often spoilt by foreign bodies, the nature of which is unknown, and which resist the action of soap. Essence of turpentine indeed may remove many stains; but it is attended with the inconvenience of attacking the colours and softening the oil which gives them body. Olive oil, and also butter, may be substituted in its stead with advantage. These two fat unctuous bodies do not attack the colours, or at least produce on them a very slow effect.

Resin, which forms the basis of the old varnishes, gives some hold to an alkaline solution composed of one ounce of potash and eight ounces of water. This is a method very much used, but it requires great care. If the alkali removes old resins, and if it converts them into a kind of soap, it exercises a similar action on the colours, or rather on the drying oil which binds the colours of the

When the varnish is made with the precautions already indicated, add prepared nut or linseed oil two ounces.

Remarks.

The matters ground with this varnish, which is nearly similar to that of Holland, dry more slowly; they are then mixed up with the following varnish, if it be for a common painting, or with particular varnishes destined for colours and for grounds. In treating of the different kinds of colours, I shall mention

painting. Long habit and the eye of a painter, therefore, are required to judge of the inconvenience of this method.

Very pure alcohol is a powerful agent, not only in removing oily stains, but also those resinous substances which constitute varnishes; and it is not attended with the inconvenience of altering the colours mixed with prepared oil. It will exercise no action on them, unless the colours have been mixed with oil of lavender or oil of turpentine. It will be proper, therefore, to ascertain the nature of the oil which has been employed, by making a trial in one of the corners of the picture.

In general it is proper to begin the cleaning of pictures by first drawing a sponge, dipped in warm water, over the surface of them: if the motion given to the sponge does not produce froth, the varnish is of a resinous nature. This washing is often sufficient to call forth the colours, and restore their original lustre.

But if the painting is covered with varnish rendered yellow by time, opake, and which absorbs the colours, place it in a horizontal direction; and having poured pure alcohol over it, keep it moistened in this manner for some minutes without employing friction. If cold water be then applied to the surface, it will remove the alcohol, and the portion of resin which has been dissolved or softened. But care must be taken not to use friction, for fear of attacking the ground. When the surface is dry, the operation is renewed until the varnish is entirely removed.

the species of varnish which ought to be employed in grinding them and in mixing them up.

Watin substitutes in the room of the Dutch varnish, which is commonly employed for grinding colours, a composition which appears to me to be too much charged with ingredients. Essence can scarcely dissolve the half of them. The rest forms a residuum which is mere loss*.

Sometimes, however, the painting is covered with a varnish composed of fat oil and insoluble resin, such as copal. In this case the attempt must be abandoned, because the purest alcohol as well as leys will produce no effect. Even essential oils, which might seem proper on such occasions, would only whiten the surface of the varnish and intercept the light, to the prejudice of the colours.

However, if the picture be of great value, and seems worth the expense, ether may be substituted with success in the room of the substances before mentioned. The property I discovered in this liquor of dissolving copal is an evidence in its favour, as being fit for the purpose in question. To this property it unites another no less essential, namely, that of not attacking the drying oil by which the colours are bound. This method is expensive, if the proper kind of ether be employed: but the loss occasioned by its evaporation may in some measure be prevented, if a cloth dipped in ether be applied to the canvas, and pressed closely down with a metallic plate or piece of glass.

When a picture is dirtied with smoke and dust, a sponge dipped in ox gall drawn over it will restore its original splendour. If it has not been varnished, it will revive the brightness of the colours, provided it be gently rubbed; and in this manner it may be prepared for receiving varnish.

Flies also dirty paintings, and render it necessary to wash them frequently. This operation is troublesome, and attended with danger. Some assert that the odour of laurel oil, which though

* See his Art of making Varnish, edit. of 1772.

Third species of the same genus. Varnish proper to be employed in mixing up colours for grounds.

No. XIV.

Take Gallipot or white incense 12 ounces.
White glass pounded 5 ounces.
Venice turpentine 2 ounces.
Essence of turpentine 32 ounces.

Make the varnish after the white incense has been pounded with the glass.

very pleasant, is disagreeable to those insects, and drives them from apartments in which it is kept. As it is of a solid consistence, it may be easily employed. Some of it put into tin-plate boxes might be placed on the cornices of rooms containing pictures worthy of being preserved from their approach.

Varnishes made with essence keep much longer in a mass than those made with alcohol. They even improve by not being immediately applied. My method is to expose them in a place well lighted, but sheltered from the direct rays of the sun. In the space of some months they become thick, and acquire an oily consistence, which renders the application of them much more advantageous.

If the varnish I have here mentioned be applied to a picture when newly prepared, the essence speedily makes its way to the colours of the painting, if it has not been before varnished, and the application of it is less œconomical than if it were a year old. It will be proper, in particular, not to apply the coatings too soon after each other, especially if the picture has been newly painted. I have known amateurs who applied three coatings of varnish in the course of two or three hours. In this case, the first coating serves as a vehicle to the second, which loses itself in part in the first: by these means an uneven surface is formed, and the application of a third is rendered necessary. But if an interval of two or three days be left after the application of the first coating, the

Remarks.

Some authors recommend mastic or sandarac in the room of gallipot; but the varnish is neither more beautiful nor more durable. When the colour is ground with the varnish No. XIII., and mixed up with the latter, which if too thick is thinned with a little essence, and which is applied immediately, and without any sizing, to boxes and other articles, the coatings acquire sufficient strength to resist the blows of a mallet. But if the varnish be applied to a sized colour, it must be covered with a varnish of the first or second genus.

Fourth species of the same genus. Changing varnish of a less drying quality than the species No. X. and applicable to metal.

No. XV.

Take Seed lac 4 ounces.
Sandarac or mastic 4 ounces.
Dragon's blood ½ ounce.
Terra merita } of each 36 grains.
Gum guttæ }
Pounded glass 5 ounces.
Clear turpentine 2 ounces.
Essence of turpentine 32 ounces.

resinous part of the varnish, which has acquired consistence, incorporates with the colours of the picture, and is capable of enduring the impression of a second coating, which will be sufficient to give the painting brilliancy, and to defend it from the attacks of moisture and of time.

Extract by infusion the tincture of the colouring substances; and then add the resinous bodies according to the prescription given for No. I.

Remarks.

Varnishes of this kind are called changing; because when applied to metals, such as copper, brass, or hammered tin, or to wooden boxes and other furniture, they communicate to them a more agreeable colour. Besides, by their contact with the common metals they acquire a lustre which approaches that of the precious metals, and to which, in consequence of peculiar intrinsic qualities or certain laws of convention, a much greater value is attached. It is by means of these changing varnishes that artists are able to communicate to thin leaves of silver and copper those shining colours observed on foils. This product of industry becomes a source of prosperity to the manufacturers of buttons and works formed with foil, which in the hands of the jeweller contributes with so much success to produce that reflection of the rays of light which doubles the lustre and sparkling quality of precious stones.

It is to varnish of this kind that we are indebted for the manufactory of gilt leather, which, taking refuge in England, has given place to that of papier maché, which is employed for the decoration of palaces, theatres, &c.

In the last place, it is by the effect of a foreign tint obtained from the colouring part of saffron, that the scales of silver disseminated in *confection d'hyacinthe* reflect a beautiful gold colour.

The colours transmitted by different colouring substances require tones suited to the objects for which they are destined. The artist has it in his power to vary them at pleasure. The addition of anatto to the mixture of dragon's blood, saffron, &c. or some changes in the doses of the more colouring bodies, will easily lead to the modifications intended to be made in colours. It is therefore impossible to give limited formulæ.

There is one very simple method by which artists may be enabled to obtain all the different tints they require. Infuse separately 4 ounces of gum guttæ in 32 ounces of essence of turpentine, and 4 ounces of dragon's blood and an ounce of anatto also in separate doses of essence. These infusions may be easily made in the sun. After fifteen days exposure, pour a certain quantity of these liquors into a flask, and by varying the doses you will obtain different shades of colour.

These infusions may be employed also for changing alcoholic varnishes; but in this case the use of saffron as well as that of red sandal wood, which does not succeed with essence, will soon give the tone necessary for imitating with other tinctures the colour of gold. The fat golden varnish already described acquires its colour from a similar mixture of tinctures.

This genus of less drying varnishes admits also another species, which approach nearly to the nature of fat varnishes, and which are known under the name of *mordants*.

Fifth species of the same genus. Varnish distinguished by the name of mordant.

No. XVI.

Take Mastic 1 ounce.
Gum sandarac 1 ounce.
Gum guttæ ½ ounce.
Turpentine ¼ ounce.
Essence of turpentine 6 ounces.

Remarks.

Some of the artists who make use of mordants substitute for the turpentine an ounce of the essence of lavender, which renders this composition still less drying.

In general, the composition of mordants admits of modifications, according to the kind of work for which they are destined. The application of them, however, is confined chiefly to gold. When it is required to fill up a design with gold leaf on any ground whatever, the composition which is to serve as the means of union between the metal and the ground ought to be neither too thick nor too fluid; because both these circumstances are equally injurious to delicacy in the strokes: it will be requisite also that the composition should not dry till the artist has completed his design.

Besides, many artists never make use of prepared mordants. They substitute in their stead an extempore mixture, which they correct at pleasure.

Some prepare their mordant with Jew's pitch and drying oil diluted with essence of turpentine. They employ it for gilding pale gold, or for bronzing.

Other artists imitate the Chinese, and mix with their mordants colours proper for assisting the tone which they are desirous of giving to the gold, such as yellow, red, &c.

Others employ merely the fat varnish of the fifth genus, No. XXI., to which they add a little red oxide of lead (minium).

Others make use of thick glue, in which they dissolve a little honey. This is what they call *batture*. When they are desirous of heightening the colour of the gold they employ this glue, to which the gold leaf adheres exceedingly well.

Every artist makes a mystery of his composition. I present mine because its qualities appear to me to be fit for every kind of application, and in particular for that to metals.

Expose boiled oil to a strong heat in a pan: when a black smoke is disengaged from it, set it on fire, and extinguish it a few moments after by putting on the cover of the pan. Then pour the matter, still warm, into a heated bottle, and add to it a little essence of turpentine.

This mordant dries very speedily; it has body, and adheres to, and strongly retains, gold leaf when applied to wood, metals, and other substances.

These examples are sufficient to show the nature of the varnishes which compose the third genus. The following genus will make the reader acquainted with others which have still more solidity.

Under the head No. XXV. will be found another mordant, still fatter, with which brown colours may be mixed.

FOURTH GENUS.

COPAL VARNISHES MADE WITH ETHER AND ESSENCE OF TURPENTINE.

Preliminary observations.

The distinction which may be established between those compositions of varnish which constitute the three preceding genera, is facilitated by various considerations. The dry nature of the resins which form the basis of them, and their friability, evidently announce that solidity is not one of their inherent qualities. The merit, indeed, of the most of these compositions seems to be confined to their drying quality and to their brilliancy. The two following genera will unite to these first characters consistence and solidity.

Copal, which serves as a basis to this fourth genus, seems to trace out an intermediate line between all the genera of varnish. The particular nature of this substance, which unites solidity to transparency, and the property I have found it to possess of entering readily into solution, in a mean temperature, or a temperature approaching that of boiling water, are so many characters which destine it to collect in varnish all the qualities which are sought for in this kind of composition.

A process which furnishes the arts with a colourless varnish, possessed of a very drying quality; a sweet odour during the time of its evaporation, and in particular a great degree of solidity; a varnish which, when extended over metallic surfaces, forms a stratum of greater hardness than that found in the vitreous crust which serves as a covering to enamel, since it opposes greater resistance to shocks and to the friction of hard bodies, ought justly to be classed among those discoveries which are most interesting to certain useful arts. Two substances only concur towards its composition: copal and rectified ether.

Had I discovered it sooner, I should not have undertaken my researches respecting the solution of copal in essence of turpentine; though the result of them may serve to extend our resources in regard to a great number of different objects.

This fourth genus of varnishes comprehends formulæ which will give so many kinds of composition; but they will not all possess the drying qualities in the same degree. This circumstance, which traces out the order of their description, indicates at the same time that they may be employed for different objects. The least drying will be proper for metallic articles; because their desiccation may be accelerated by means of a stove.

The theoretical observations I have already laid before the reader, in the preliminary remarks in regard to varnishes of the third genus, are perfectly applicable to those which form the fourth genus, since they exhibit all the qualities of the best varnish.

First species. Copal varnish with ether.

No. XVII.

Take Ambery copal ½ ounce.
Ether 2 ounces.

Reduce the copal to very fine powder, and introduce it by small portions into the flask which contains the ether; close the flask with a glass or a cork stopper, and having shaken the mixture for half an hour, leave it at rest till the next morning. In shaking the flask, if the sides become covered with small undulations, and if the liquor be not exceedingly clear, the solution is incomplete. In this case add a little ether, and leave the mixture at rest. The varnish is of a light lemon colour.

Remarks.

It appears to me astonishing, that this property which ether possesses of becoming charged with copal should have escaped Macquer, who subjected caoutchouc to a variety of experiments for the same purpose. It is probable, that the knowledge he had obtained of the little effect which ether produces on amber, prevented him from trying it on copal, the properties of which it was then usual to confound with those of amber.

The affinity which ether has for copal is so great, that when the powder is poured into the flask, some particles of it, seized by the vapour as it escapes from the flask, soon form small stalactites, extending from the extremity of the card which supports the powder to a considerable distance within the mouth of the flask. The attraction of fine iron filings, put in motion by the presence of an artificial magnet, will give to persons acquainted with magnetic effects a perfect idea of this phænomenon.

When copal is presented to ether in small portions, as I have indicated, the powder which falls to the bottom assumes the form of a small mass, the volume of which decreases in a very sensible manner: under these circumstances it exhibits the same phænomena as a bit of sugar in cold water, except the bubbles of air disengaged from the sugar, and which are not produced from copal.

Copal without colour, or very little coloured, passes more slowly and in less quantity into ether. Copal very much of an ambery nature was that which appeared to me to succeed best.

According to the observations which I made, the largest quantity of copal united to ether may be a fourth, and the least a fifth. The use of copal varnish made with ether seems, by the expense attending it, to be confined to repairing those accidents which frequently happen to the enamel of toys, as it will supply the place of glass to the coloured varnishes employed for mending fractures, or to restoring the smooth surface of paintings which have been cracked and shattered.

The great volatility of ether, and in particular its high price, do not allow the application of this varnish to be recommended but for the purposes here indicated. I have seen it applied to wood with complete success, and the glazing it produced united lustre to solidity.

In consequence of the too speedy evaporation of the liquid it often boils under the brush. I found means, however, to retard its evaporation by spreading over the wood a slight stratum of essential oil of rosemary, or lavender, or even of turpentine, which I afterwards removed with a piece of linen rag: what remained was sufficient to retard the evaporation of the ether.

Second species. Copal varnish with essence of turpentine.

No. XVIII.

Take Copal of an amber colour and in powder 1½ ounce.
Essence of turpentine 8 ounces.

The specific gravity of the essence ought to be seven gros, and from 50 to 52 grains in a flask containing an ounce of distilled water; Fahrenheit's thermometer being at 59°.

Expose the essence to a balneum mariæ, in a wide-mouthed matrass with a short neck: as soon as the water of the bath begins to boil, throw into the essence a large pinch of copal powder, and keep the matrass in a state of circular motion. When the powder is incorporated with the essence add new doses of it; and continue in this manner till you observe that there is formed an insoluble deposit. Then take the matrass from the bath, and leave it at rest for some days. Draw off the clear varnish, and filter it through cotton.

Remarks.

At the moment when the first portion of the copal is thrown into the essence, if the powder precipitate itself under the form of lumps, it is needless to proceed any further. This effect arises from two causes: either the essence does not possess the proper degree of concentration, or it has not been sufficiently dephlegmated (deprived of water). Exposure to the sun, employing the same matrass, to which a cork stopper ought to be added, will give it the qualities requisite for the solution of the copal. This effect will be announced by the disappearance of the portion of copal already put into it.

The excipient which I propose to apply to copal, without any intermediate substance, is by most artists considered as entirely destitute of energy. Some chemists have given a contrary opinion, and I profess myself to be one of that number. I shall collect under one point of view, and consequently in a particular chapter, the experiments I made to decide this question, which relates to the solubility or insolubility of copal in essence. The results appear to me more interesting, as they are not confined to this single fact. They conducted me indeed to a series of observations which are foreign to the subject of this work.

To obtain this varnish colourless, it will be proper to rectify the essence of the shops, which is often highly coloured, and to give it the necessary density by exposure to the sun in bottles closed with cork stoppers, leaving an interval of some inches between the stopper and the surface of the liquid. A few months are thus sufficient to communicate to it the required qualities. Besides, the essence of the shops is rarely possessed of that state of consistence, without having at the same time a strong amber colour.

The varnish resulting from the solution of copal in essence, brought to such a state as to produce the maximum of solution, is exceedingly durable and brilliant. It resists the shock of hard bodies much better than the enamel of toys, which often becomes scratched and whitened by the impression of repeated friction; it is susceptible also of a fine polish. It is applied with the greatest success to philosophical instruments, and the paintings with which vessels and other utensils of metal are decorated.

Third species. Copal varnish, made with essence by means of an intermediate substance.

No. XIX.

Take Copal in powder 1 ounce.
Essential oil of lavender 2 ounces.
Essence of turpentine 6 ounces.

Put the essential oil of lavender into a matrass of a proper size, placed on a sand bath heated by an Argand's lamp, or over a moderate coal fire. Add to the oil while very warm, and at several times, the copal powder, and stir the mixture with a stick of white wood rounded at the end. When the copal has entirely disappeared, add at three different times the essence almost in a state of ebullition, and keep continually stirring the mixture. When the solution is completed, the result will be a varnish of a gold colour, exceedingly durable and brilliant, but less drying than the preceding.

Remarks.

This method may have some advantage over the preceding, in case essence of a proper specific quality, and such as I have recommended, can be procured.

Essence, whatever be the state of its specific gravity, is capable in this particular case to dissolve copal, and so also is alcohol. This may be easily proved by a very simple experiment, which requires no great apparatus.

Put essential oil of lavender into a table spoon, and heat it by placing it over a chaffing-dish. When it is almost in a state of ebullition add a pinch of copal in powder. Facilitate the mixture by means of a straw; and when the copal has disappeared, add a new dose till the oil refuses to receive any more. Pour the solution into a phial containing boiling alcohol, and stir the mixture, keeping it always at the same degree of temperature. The alcohol will soon seize upon both these substances. The alcohol employed in this experiment must be pure; for the smallest quantity of water, foreign to its composition, would precipitate the copal, which would then unite into a mass.

The success of this experiment often depends on a dexterity, which may easily be acquired by persons accustomed to such operations.

If you are desirous of completing the experiment without changing the vessel; that is to say, if you employ a metallic vessel capable of containing the alcohol added to the oily solution of copal, a part only of the boiling alcohol must be poured in, stirring the mixture with the stick. The copal, which forms itself into a ball, soon enters into the vehicle. This circumstance allows the remainder of the alcohol to be added, without the least fear of any precipitation.

It may be readily perceived that this varnish belongs to the second genus, which comprehends the less drying spirit varnishes. I introduce it here, merely to serve as a new proof of the existence of processes capable of effecting a complete solution of copal in the different liquids commonly employed in the composition of varnishes. If stronger doses were employed in this process, the varnish-alembic, which I shall describe in the following chapter, would be exceedingly proper.

Fourth species. Copal varnish by an intermediate substance, according to a method given in the Journal de Physique.

No. XX.

Take Copal 4 ounces.
Clear turpentine 1 ounce.

Put the copal, coarsely pulverized, into a varnish pot, and give it the form of a pyramid, which must be covered with turpentine. Shut the vessel closely, and, placing it over a gentle fire, increase the heat gradually that it may not attack the copal. As soon as the matter is well liquefied, pour it upon a plate of copper, and when it has resumed its consistence reduce it to powder.

Put half an ounce of this powder into a matrass with four ounces of the essence of turpentine, and stir the mixture till the solid matter is entirely dissolved.

Remarks.

This varnish is coloured, and has no advantage over that of No. XVIII. The turpentine, which by the action of the heat has undergone a commencement of decomposition, even before the copal has entered into a state of liquefaction, contributes greatly to give it this colour. In this respect it is not better than No. XIX. It is even inferior to it.

Fifth species. Copal varnish by the medium of camphor and essential oil of lavender, destined for articles which require durability, pliableness, and transparency; such as the varnished wire gauze used in ships instead of glass.

No. XXI.

Take Pulverized copal 2 ounces.
Essential oil of lavender 6 ounces.
Camphor $\frac{1}{8}$ of an ounce.
Essence of turpentine a sufficient quantity, according to the consistence required to be given to the varnish.

Put into a phial of thin glass, or into a small matrass, the essential oil of lavender and the camphor; and place the mixture on a moderately open fire, to bring the oil and the camphor to a slight state of ebullition. Then add the copal powder in small portions, which must be renewed as they disappear in the liquid. Favour the solution by continually stirring it with a stick of white wood; and when the copal is incorporated with the oil, add the essence of turpentine boiling; but care must be taken to pour in at first only a small portion.

An inverse method might be followed, by pouring the essential oil camphorated and boiling on the copal, liquefied separately in the matrass; but this method requires more practice. Besides, it would give to the varnish a darker colour.

This varnish is little coloured; and by rest it acquires a transparency which, united to the solidity observed in almost every kind of copal varnish, renders it fit to be applied with great success in many cases, and particularly in the ingenious invention of substituting varnished metallic gauze in the room of Muscovy talc, a kind of mica in large laminæ, used for the cabin windows of ships, as presenting more resistance to the concussion of the air during the firing of the guns. Varnished metallic gauze of this kind is manufactured, I believe, at Rouen, or in the neighbourhood.

All these attempts, the principal object of which was to find the means of making copal unite with any liquid, without having recourse to the influence of too high a temperature, which might alter the principles of its composition, seem to point out the boundaries of the art, without destroying the hope of obtaining complete success. The pliableness and tenacity observed in this singular substance, when subjected to a series of processes, give reason to believe that it may rival that which constitutes the Chinese varnish, provided the solution of it can be rendered easy, and secure from those alterations which take place during the common operation. It does not appear that the different intermediate substances, hitherto employed, have been attended with complete success, or at least such success as supersedes the necessity of further researches.

Before I proceed to a simpler method, I must here offer some observations and experiments in regard to the influence of intermediate substances, and particularly that of camphor, or the solution of copal in alcohol. Though this object relates chiefly to varnishes of the first genus, it seems connected with that of which we here treat, and admits of this transposition.

The camphor which I have employed for thirty years, as a medium to facilitate the solution of resin in the composition of varnish destined for valuable paintings *, might be applied in my process in doses of from 24 to 30 grains for every ounce of the oil of lavender. It has indeed the singular property of altering the consistence of the driest resins, and of rendering them soft. In this union, which appears to be intimate, the camphor itself loses the character which distinguishes it from an essential oil, that is to say, dryness. Apothecaries have every day an opportunity of verifying this fact, when they prescribe a mixture of camphor in plasters the base of which is resinous. It softens them to such a degree, that it is impossible to preserve the

* See No. XII.

consistence of plaster, if the dose be carried beyond 30 or 40 grains for each ounce of resin.

Mr. Timothy Sheldrake mentions camphor as a medium for dissolving copal in essence and alcohol. He gives also another process, in which ammonia (volatile alkaline spirit of sal ammoniac), in the proportion of an eighth part of the essence employed, is substituted in the room of camphor *.

Experiment I.

Of the three processes which he describes I repeated two; those which regard the solution of copal in essence and in alcohol by a mixture of camphor. That with essence did not succeed. The author himself announces that he always failed, except when he obtained the essence from Apothecaries'-hall. It appears that this essence had by chance all those essential qualities which we endeavour to give it by time, and still more speedily by the influence of light.

Experiment II.

The same experiment repeated with pure alcohol was attended with too little success to make the result be considered as a varnish. The alcohol appeared milky, and the copal formed at the bottom of the vessel a mass which did not seem to have decreased in volume. Next morning the interposed part of the copal, which altered the limpidity of the alcohol, was precipitated, and adhered to the sides of the glass. The process I have described for spirituous tincture of amber would give more hopes of success, without any intermediate substance.

* See Bibliothèque Britannique, vol. xiii.

In regard to the means proposed by the medium of ammonia, the saline nature of that liquid, if the process succeeds, will not admit of the product being placed in the class of varnishes destined for delicate painting. It is a kind of saponaceous compound, the use of which is not to be recommended in such cases.

Experiment III.

Another process in which the dose of camphor employed as the means of union is much greater than in the two preceding processes, may be found in the Philosophical Transactions. The author says, that by making it equal to that of the copal, the whole of the latter will dissolve in the alcohol. Though this quantity of camphor appears to me to be far too great to render the solution of the copal applicable to cases which require the use of varnish, I followed the process exactly.

I triturated forty grains of camphor with as much amber-coloured copal. I employed the same for all my experiments. I put this powder into two ounces of alcohol of the first quality, stirred it strongly for a minute, and then placed it on a fire of very hot cinders, continuing to stir it. The liquid soon boiled, notwithstanding the state of agitation in which I kept it, to prevent the resin from adhering to the glass. I entertained no doubt in regard to the power of the alcohol over the camphor, though the intimate union which it enters into, in this case, prevents a complete solution. The case was not the same with the copal; the solution of which, to judge by the appearance of the liquid, seemed to me very problematical. It was indeed precipitated, and produced a small mass, which adhered to the glass. On decanting the liquid, which had a milky appearance, I was able to separate the copal, which, though it retained a soft consistence, adhered very little to the metallic spatula. This matter, when dried in a gentle heat, weighed still twenty-three grains, and appeared to me as dry as common copal.

The decanted liquor retained for some days its nebulous appearance, notwithstanding the first separation of the resinous parts interposed. The vessel at length was incrusted with a thin coating of copal; but I neglected to ascertain the quantity.

Though this camphorated liquor could not be considered as a varnish, I thought it my duty to make a trial of it on a piece of card, which had already received two coatings of fish glue. Three successive strata of camphorated liquor gave no satisfactory result: in a word, it was not a varnish.

Experiment IV.

Being convinced by preceding researches respecting the differences observed in experiments of this kind, when different specimens of copal are employed, I endeavoured to clear up my doubts by changing the copal. I therefore repeated the experiment with specimens almost colourless, and of the greatest purity. I observed a difference at the very moment of mixture. The resin was perfectly diluted; and its state of division between the moleculæ of the liquid was such, that the rotary motion I maintained gave to the whole a clouded appearance. The kind of threads which circulated in the mass did not fall down; but, notwithstanding this phænomenon, which I always considered as very favourable to solution, and the motion I communicated to the vessel and that occasioned by ebullition, the resin united itself under the form of fibres, which settled at the bottom of the vessel. The precipitated copal when properly dried weighed ten grains. The liquid retained opacity, and some days after there was formed a sediment around the vessel, as in the preceding experiment. Still, however, it did not form varnish, though it contained more copal than that of the third experiment. But it presents us with a new fact, which may be turned to advantage.

Experiment V.

What I had done rendered it necessary for me to try the union of camphor with the brown copal, making use of an oily excipient, which hitherto had appeared to me the properest for succeeding with this variety of copal. I therefore mixed twenty-four grains of copal with as much camphor, and formed it into a paste, which I treated with an ounce of the common essence of turpentine. I produced from it a small mass, which, after exposure to the sun for twenty days, still retained pliableness, and an elasticity which might be compared to that of caoutchouc. In this state it weighed twenty-four grains. This result, which I verified on several other occasions, furnishes perhaps a key to one of the processes employed by some of the miners in Ducal Prussia, to give different colours to amber, and to render it elastic. The intimate union which takes place between the parts of the camphor, the copal, and a small quantity of oil, is, no doubt, alone capable to explain this state of consistence. In a word, this union appears to me to be of such a nature as to weaken in these two substances those properties by which they are best characterized: the extreme volatility of the camphor, and the consistence of the copal. Six months after, this small mass, left in a window and exposed to the sun for some hours every day, still retained a pretty solid nucleus, of a brilliant and vitreous fracture, but sufficiently soft to admit the introduction into it of a needle. This nucleus was incrusted in a spongy, friable matter of a grayish colour. The crust formed about a third of the whole mass.

Experiment VI.

The same dose of camphor and of colourless copal, treated with the same quantity of essence, disappeared almost entirely a few moments after its mixture. In this case the liquor exhibited all the characters of varnish. A small portion, however, was precipitated, which when collected and dried weighed 3½ grains.

Experiment VII.

One point still remained to be verified in regard to the success of the last experiment: Had not the essence I employed acquired, by the effect of chance, that disposition or particular state which is communicated to it by the solar light? In a word, might it not be compared to that which is rendered proper, without any medium, for the solution of copal*?

To resolve this question, I subjected to an ounce of the same essence twenty-four grains of the last-mentioned copal without colour. Agitation of the liquid gave signs favourable to the required solution; and after the action of heat had removed the moleculæ of water interposed between those of the essence, there

* See Chap. V. Part I.

remained no more than four grains and a half of copal united into one mass in one part of the phial.

In the course of these different trials we observe anomalies which depend, in a particular manner, on the nature of the copal, and the state of the oily liquid. Copal which has much of an ambery colour, and even the brown, which for fat varnishes, or those of the fifth genus, is preferred to that destitute of colour, loses in our third and fifth experiments its pre-eminence over the latter, when the object is a solution in alcohol or essence of turpentine, with or without any intermediate substance. As the first two experiments were made some time before the one in question, I did not think of making a series of comparative trials, employing all the varieties of tint observed in the copal of the shops. I introduce them here merely that I may add, if possible, to the confidence which artists ought to place in the experiments I present to them, and to suggest new subjects of research to those who may be inclined to pursue them.

From all these facts it is probable, that the difference observed in the result of the attempts made by different authors has arisen rather from the nature of the copal employed than from the method they employed. I must, however, confess that practice is necessary for such researches, and that the same materials which give successful results in experienced hands, give only very uncertain results in others. I am, therefore, far from bringing forward my own experiments, as arguments sufficient to render useless all those of my predecessors.

Reflecting, however, on the different resources of mercantile fraud, and the facility they afford for deceiving persons of considerable experience, there is reason to think, that certain solutions of copal, rendered easy, in part or in whole, by the proposed medium, may have nothing of copal but the name. This opinion might appear too severe, and even misplaced, had we not recent instances that sandarac, copal in small fragments, and amber, have reciprocally served to cover each other for sale; and had we not seen, in particular, gum anima new, and consequently in very transparent fragments, pass for copal, notwithstanding its greater friability, and the sweet odour it emits by friction. I shall abstain from any observations on the high doses of camphor prescribed for these different solutions. It may enter with copal into such a state of combination as to lose by it a part of its volatility. This state of union appeared to me very important, and well deserving of new researches. I must here remark, that the addition of camphor in the sixth experiment was useless, as the solution of that variety of copal evidently depended on the state of the essence, as is seen in the seventh mixture.

Like many artists, I tried copal according to methods of my own: but not being satisfied with the researches, the results of which I have here communicated, I endeavoured to overcome all the difficulties which occur in the composition of copal varnish, whether it be required colourless, by employing essence subjected to preliminary preparation, or whether, sacrificing this advantage, which is doubtless very great, to the qualities found in drying oils, the methods reserved for varnishes of the fifth genus be followed. I ought to consider myself very fortunate if I should be able to substitute a method which holds a mean place, and which is sufficiently sure to deserve being recommended.

The first object of those who compose varnish is to preserve the particular properties of the substances which form it. The great solubility of most resins in their appropriate liquors, determined the choice of some particular ones for the varnishes of the first, second and third genera; and it supersedes the necessity of complex researches. We have indeed seen, that the simple contact of resins with certain oils, or with alcohol, assisted by motion, or the temperature of from 50 to 60 degrees of Reaumur (from 144° to 167° of Fahrenheit), or even that of the sun, is always followed by a success greater or less according to the nature of the resin employed.

The series of my processes in regard to copal, and those employed for amber, exhibit however difficulties which I never before experienced. These substances require other means; and notwithstanding the difference observed between them, with respect to their soluble property, they seem to be nearly on the same footing, and to deviate in a considerable degree from all the resins yet known, when considered as connected with the composition of varnish.

Stopped by the difficulties with which the solution of these bodies is attended when the usual processes are applied, the artist found himself obliged to attack, in some measure, the extreme cohesion of the aggregate moleculæ of which their mass is composed, and to alter a little the state of composition, by applying to them a degree of heat much superior to that which is proper for simple infusion. This method corresponded very well, in part, to his views; but the dark colour which the varnish assumes is an inconvenience which confines the use of it to certain grounds and to certain colours.

Hitherto art has made no attempt to obtain a more satisfactory result; it has introduced no change in the usual processes; in a word, it has proposed no other modification to preserve the first liquefied portions of the copal from alterations occasioned in it by the continued impression of caloric (the heat), but the sacrifice of that part which is only softened. In this respect I consider myself as more fortunate; since my attempts have always been crowned with success; and nothing is required to obtain it but a modification in the process which I employ for the fifth genus of varnish. It is, however, necessary to have a particular furnace, of which the following is a description:

Description of a furnace destined for the liquefaction of copal and amber.

Those who have examined in detail the laboratories destined for a course of chemistry, may easily form a clear idea of the construction of this furnace, by recollecting that employed for separating sulphuret of antimony from its matrix. But to render it fit for the object in question requires some alterations; by the help of which one may use it without inconvenience for the liquefaction of solid resins, and even for mixing them with drying oils.

This furnace, a section of which is represented fig. 1. Plate IV, may be entirely constructed of burnt clay, three large apertures being made in the lower chamber, A, which supplies the place of an ash-hole in the common furnaces. The upper part of these apertures is arched; and the pillars or solid parts between them should be as narrow as possible, in order to enable the artist with facility to extract the liquefied matter, and even to mix it with the drying oil, if this kind of varnish be required.

The upper part, B, or fire-place of the furnace, is separated from the lower part, A, by a bottom or plate, which answers the same purpose as a grate in the common furnaces. This plate has in the middle a circular aperture, the diameter of which corresponds to that of the tube, C, which it is destined to receive, and which extends a considerable way below it. This plate may either form one piece with the furnace, or may be moveable. In the latter case it is supported by three projections, or by a circular ledge which projects inwards. In my furnace this partition is composed of an iron plate covered with a coating of potters' clay an inch in thickness. This precaution is indispensably necessary to prevent the heat from penetrating to the lower division, A.

The sides of the fire-place, B, are pierced with holes an inch in diameter, and distant from each other about three inches. These apertures admit air sufficient to maintain the caloric (heat) at the degree proper for this kind of operation. The following are the proportions of the three parts of this furnace, which served me for my experiments, and in which I liquefied six ounces of copal in the space of ten minutes, without altering its colour in a sensible manner.

	Inches.
Total height of the furnace - - - - - -	$17\frac{1}{2}$
Height of the lower chamber, A, including the bottom, which was an inch in thickness - - - - - - - - - - - - -	11
Height of the upper chamber, B, or of the fire-place - - - - - - - - - - - -	$5\frac{1}{2}$
Diameter, taken at the upper interior edge of the fire-place, B - - - - - - - -	$9\frac{1}{2}$
Diameter of the same, taken at the bottom or partition - - - - - - - - - - - -	7

This part decreases in diameter $2\frac{1}{2}$ inches, tapering towards the lower part of the furnace, A.

The tube, C, is conical at the upper extremity and cylindrical towards the bottom: it is $9\frac{1}{2}$ inches in length, $4\frac{1}{2}$ in diameter at the top, and $2\frac{1}{2}$ towards the middle. Both ends of it are open.

The tube, C, is placed in the aperture formed in the middle of the partition, in such a manner as to rise 3 or 4 inches into the fire-place. The place where it joins to the partition is luted with clay, to prevent the ashes or small coals from falling down.

When this arrangement is made, the net, D, (see fig. 2.) made of brass wire worked very open, is placed in the tube. It has the shape of a funnel, the upper edge of which is made fast to a ring of wire of the same diameter as the upper part of the tube, C. The decrease in the diameter of the tube C conduces to the stability of this net, and the conical form of the latter prevents it from coming into contact with the lateral parts of the tube, which is a matter of great importance to preserve the copal from too great alteration by the heat.

The copal is placed on this metallic filter in pieces not larger than a small nut, and the whole is closed up with the iron plate or cover, E, an inch in thickness, taking care to lute the joining with clay, to prevent all communication with the exterior air.

A shallow dish or capsule, F, filled with water, (fig. 3.) is placed under the bottom of the tube, C, in such a manner that the tube is immersed in the water two or three lines.

The fire-place, B, being filled with burning coals so as to rise above the iron cover of the tube, the first impression of the heat on the copal is announced by a kind of crackling, the consequence of its dilatation, which makes it split into small pieces. This noise is a sign of beginning liquefaction, which indeed takes place soon after. A small iron pallet-knife terminating in an elbow is introduced under the tube, and moved in such a manner as to cause the liquefied part of the copal to fall down into the water, and to bring it under the solid form towards the edge of the capsule. When the operation is finished, the copal is spread out on dry

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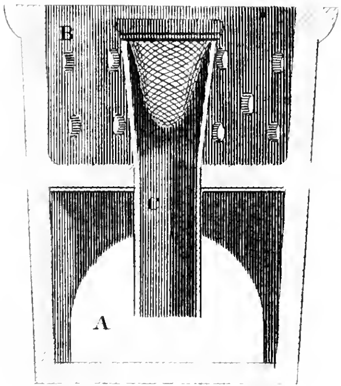


Fig. 1.

E

Fig. 2.

F


Fig. 3.

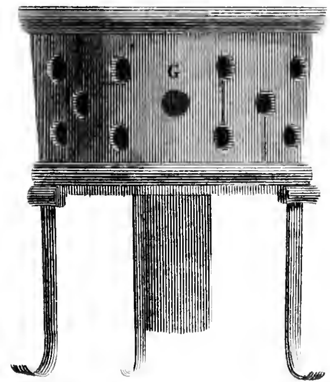


Fig. 4.

linen cloths, or on unsized paper, to dry; it is then piled up and exposed to a gentle heat, to deprive it of all its humidity.

While the copal is falling down there is separated a very small portion of oil, which remains fluid after the operation. It floats on the water as well as the copal, and gives to the latter a greasy appearance. But when the tube is of sufficient length there will be no necessity for immersing the end of it in the water, or even for receiving the matter in the water; but, in this case, a kind of smoke will escape, which may be offensive to the artist. The essential point is to graduate the fire in such a manner as not to alter the colour of the copal. When a very thick smoke issues through the lower aperture of the tube; when the latter is very red; and when the drops which fall into the water rise into bladders and form small explosions, there is reason to conclude that the fire is too violent.

I have succeeded in composing varnish with fat oil, in the same operation, by substituting for the water drying oil in a state of ebullition, and maintaining it in that state by means of a mass of very hot iron, which served it as a supporter. The mixture of the liquefied matter is facilitated by means of a spatula, with a knee at the extremity; and the boiling essence is afterwards added. The inconvenience of placing under the apparatus a volatile and highly inflammable oil may be readily conceived.

I shall always insist more on the separate liquefaction of copal, than on the possibility of completing the mixture of it with a drying oil, to form a varnish of the fifth genus. This new mean enables the artist to compose a very durable varnish, very little coloured, and superior to copal varnish composed with drying oil, as the composition of the latter requires processes which alter the essential qualities of the substances that form the basis of it.

For operations on a larger scale the dimensions of the furnace may be changed; but in this case it will be proper to establish the fire-place, properly so called, on a kind of iron tripod, as represented at G, fig. 4, in order that the workman may be more at his ease. I must however always insist on the advantage of employing, in the process, doses of only four and six ounces.

The valuable advantages which accompany this new method will be perceived when a trial has been made of the varnish composed with essence of turpentine, which results from it. Copal thus prepared has properties different from, and more extensive than, those communicated to it by the common method; and it has not that dark brown colour which it acquires by too high a temperature, and too long exposure to heat. Immersed here in an atmosphere of caloric (heat), it receives the impression only at the surface, which soon yielding to the power of that agent escapes under the liquid state from the continuance of its action; new surfaces are successively subjected to the same effect; and the final result is copal as little altered as possible, and which can have undergone but a very slight modification in its constituent principles: the force only of the connexion which existed between its parts, and which opposed so great an obstacle to the solutions proposed to be effected, is diminished. In a word, it is possible to compose fat copal varnish almost colourless, by making use of oil as little coloured as possible; such as that of pinks prepared in leaden vessels, according to Watin's method.

In like manner also this copal, simply modified, may increase the solidity of alcoholic varnish in a more direct manner than when it is employed without any preliminary preparation. A second liquefaction would perhaps give it the property of being soluble in alcohol in greater quantity; but there would be reason to apprehend that the alteration in its principles, carried too far, would give it no superiority over those resins which are most soluble in that liquid. I shall conclude what relates to this fourth genus of varnishes with an account of the experiments I made by applying copal thus prepared to the most usual vehicles.

Sixth species. Copal varnish with essence of turpentine, without any intermediate substance.

No. XXII.

Take Copal liquefied, according to my method, 3 ounces.
Essence of turpentine 20 ounces.

Place the matrass containing the oil in a balneum mariæ, and when the water is warm add the pulverized copal in small doses. Keep stirring the mixture, and add no more copal till the former be incorporated with the oil. If the oil, in consequence of its particular disposition, can take up three ounces of it, add a little more; but stop when the liquid becomes nebulous; then leave the varnish at rest. If it be too thick, dilute it with a little warm essence, after having heated it in the balneum mariæ. When cold, filter it through cotton, and preserve it in a clean bottle.

This varnish has a good consistence, and is as free from colour as the best alcoholic varnish. When extended in one stratum over smooth wood, which has undergone no preparation, it forms a very brilliant glazing, which, in the course of two days in summer, acquires all the solidity that may be required.

The same essence employed with copal of two fusions, that is to say, copal liquefied a second time, takes up a third more than in the former case. But it produces very little effect on copal not prepared.

The facility which attends the preparation of this varnish by the new method here indicated, will admit of its being applied to all coloured grounds which require solidity, pure whites alone excepted. Painted boxes, therefore, and all small articles, coloured or not coloured, where it is required to make the veins appear in all the richness of their tones, call for the application of this varnish, which produces the most beautiful effect, and which is more durable than turpentine varnishes composed with other resinous substances.

New experiments and observations on copal.

Though essence of turpentine, by the state of its composition, be more proper than alcohol for the preparation of varnish, when it is required that it should unite durability to splendour, there are many cases in which alcoholic varnishes must be employed; and the latter require no less attention on the part of the artist. To point out, therefore, the means of adding to their intrinsic qualities already known, another of still greater importance, namely, solidity, is doing a service to the art. Copal treated according to my method is better fitted to answer this end, as its colour is very little altered. I shall here collect some experiments which I made on this subject, with a view of pointing out to those who pursue researches of this kind, what has been accomplished and what still remains to be done. I must here observe that the alcohol I employed was exceedingly pure.

Experiment I.

Two deniers of copal, liquefied in a matrass with a fourth of its weight of camphor, pulverized and digested for ten days in an ounce and a half of alcohol, scarcely communicated to it any colour; and the specific gravity had increased, at the same temperature, only two grains.

The mixture being subjected to the heat of a balneum mariæ assumed a slight nebulous tint. This addition to the process had increased the specific gravity of the liquid 3½ grains. The camphor seems to have been the cause of this increase, if we may judge from the colour-of the infusion, which was not more charged than before.

Experiment II.

Thirty-six grains of copal of one fusion*, and which had been exposed to sufficient heat to undergo a slight inflammation, occasioned by a defect in the construction of the tube, and an ounce and a half of alcohol presented a complete solution in two days. A new dose of the same copal increased the lemon colour of the liquid, without appearing to decrease much in volume after ten days' digestion. At this period the specific gravity of the liquid exhibited an increase of six grains. Its fluidity did not seem to be sensibly affected, and the copal retained a pulverulent form.

When treated in a balneum mariæ the copal formed itself into a mass. This circumstance seemed to be prejudicial to the solution, as the specific gravity of the infusion showed an increase only of two grains. It appears evident that the union of the free parts of the copal had favoured the separation of a portion of that which was in the state of solution, as I always took care to wait for the return of the same temperature before I verified the specific gravity of my liquors.

* To avoid circumlocution in the account of these experiments, I shall give the common name of copal to that which has been subjected to no preliminary preparation before being pulverized; that of copal of one fusion to copal which has undergone liquefaction only once, according to my method; and that of copal of two fusions to copal which has been twice liquefied according to the same process.

Experiment III.

Thirty-six grains of copal of one fusion, and which had been received in water at the time of its liquefaction, on examining its specific gravity showed an increase of only two grains and a half after being digested ten days in 1½ ounce of alcohol. The colour of the liquid had experienced very little change.

This digestion treated in a balneum mariæ abandoned a part of its tint, and lost some of its specific gravity, which was reduced to 1½ grain of increase.

Experiment IV.

A mixture made cold of two ounces of copal of one fusion, and an ounce and a half of coarsely pounded glass in twelve ounces of alcohol, remained in the pulverulent state during the whole time of a long digestion, even when assisted by some exposure to the sun's rays, and stirring the mixture from time to time. The glass in this case contributes to the permanence of that state. Some minutes after mixture the liquid assumed an ambery tint, which afterwards became darker.

After fifteen days' digestion the specific gravity of the alcohol was found to be greater by seven grains.

What had taken place in the second and third experiments made me omit, in this case, to employ a balneum mariæ: I preferred long digestion. Three months' infusion had carried the increase of the specific gravity to thirteen grains per measured ounce of liquid; but the mixture did not form a varnish.

Experiment V.

I mixed two gros of copal of one fusion with the same quantity of camphor and six ounces of alcohol.

To facilitate the action of the alcohol I pounded in a mortar, for a full hour, the camphor and the copal, moistened with some drops of alcohol: the addition then of one-sixth of alcohol extracted from it a liquor of a limpid and ambery tint. The mass, which had become soft, exhibited the consistence and appearance of turpentine which has been kneaded in warm water, and drawn out into the form of a cord between the fingers. A new dose of alcohol rendered the liquid milky; but it soon after deposited the divided portion of the copal which gave it that appearance. The sediment remained pulverulent. It was under this state that the successive addition of alcohol reduced the whole of the small mass of camphorated copal. The liquid separated from the divided portion, which disturbed its transparency, had acquired a very dark orange colour: some days after, this colour had become more intense. At this period the specific gravity showed an increase of six grains.

The use of a balneum mariæ carried this increase in half an hour to fourteen grains; but during this operation the copal formed itself into a mass, and its consistence was soft, and so tenacious that I was able to take it from the vessel with the stick which had served to keep it in motion: this matter had a greenish tint. When exposed for twelve days to the temperature of seventy-two or seventy-seven degrees of Fahrenheit, this small mass still retained its flexibility; but its surface was white and as it were farinaceous, the effect of the *transudation* of a part of the camphor.

Though the spirituous infusion appeared to be charged, it did not contain a sufficiency of copal to make it answer the conditions of a varnish. However, when spread out by means of a brush on wood prepared with gum, the first stratum gave indications of varnish, and the third formed a complete varnish. But this varnish, which was exceedingly slow in drying, since at the end of six days it still adhered to the fingers when placed on it for some time, became tarnished during its desiccation. This effect, which is unknown when our turpentine copal varnishes are employed, may be explained by the particular union which copal forms with camphor.

Experiment VI.

One gros of copal powder fused in a matrass with a third of its weight of gum sandarac, put into a mixture of nine gros of alcohol and three gros of sulphuric ether, exhibits nearly the same phænomena as the preceding mixtures. It sustains pretty well the division of its parts, and gives to the liquid a lemon colour; but it disturbs its limpidity. Its specific gravity, examined after eight days' digestion in a window which received the solar rays three hours each day, gave an increase of full eight grains.

It appears probable that the cloudiness which the liquid retains arises from a partial precipitation of the copal attacked by the ether, and precipitated in part by the alcohol, which does not exercise over it the same energy.

The infusion treated in a balneum mariæ became clearer, without being perfectly limpid. This effect might be ascribed to the evaporation of a part of the ether. The state of the solution experienced scarcely any change from this process, since the total increase observed in the specific gravity of the liquid was only nine grains. The matter still retained its pulverulent form.

Experiment VII.

The same quantity of copal united to sandarac, thrown into an ounce and a half of alcohol, becomes very much divided, and remains pulverulent. The liquid assumes a beautiful gold colour, without losing any of its limpidity. Eight days' digestion added only two grains more to the weight, which expressed its specific gravity.

The balneum mariæ doubles this addition. In the last process the matter had retained the pulverulent form, for which it was indebted to the sandarac.

Experiment VIII.

It appeared necessary that I should compare the effect of a mixture of alcoholized ether on copal, liquefied according to my method, with that of the mixture which had served for the sixth experiment, in order that I might appreciate better the influence of the sandarac. The same doses were employed for the present experiment. The copal became soft, and formed at the bottom of the vessel a small mass, pretty similar in consistence and colour to turpentine. It however yields to violent stirring, and extends in the liquid under the form of very thin leaves, which by rest are soon collected into a mass. The liquid assumes a beautiful lemon colour, somewhat greenish: but it is less charged than in the two preceding experiments.

The ether does not appear to have here so striking an influence as on copal mixed by fusion with sandarac; since digestion for eight days, in the same window, added only two grains to the specific gravity of the liquid.

The application of a balneum mariæ only doubled this addition. This process seems to have no advantage over those of the first and second experiments.

As the copal seems to give more hold to the alcohol when divided by an intermediate body, or when modified by one liquefaction, there might be reason to hope that a second would add to the extent of the solution, by taking copal of two fusions received each time in a vessel filled with water.

Experiment IX.

Two gros of copal of two fusions, one ounce of coarsely pounded glass, and eight ounces of alcohol, treated as the mixture of the fourth experiment, gave to the liquid an orange colour; and eight days after the addition to the specific gravity was six grains: three weeks after it was nine grains.

The application of a balneum mariæ formed of it a mass. This solution seemed to exhibit no more advantages than that of the 4th experiment, with copal of only one fusion.

Experiment X.

Thirty-six grains of copal of two fusions, mixed with an ounce and a half of alcohol, maintain themselves pretty well under the pulverulent form, during a digestion of ten days. The liquid assumes little colour, and its specific gravity is increased only three grains.

By the use of a balneum mariæ the liquid becomes turbid when cold; the copal forms itself into a mass, and the increase of its specific gravity is reduced to two grains.

Experiment XI.

The same quantity of copal of two fusions put into the ethereous mixture of the sixth and eighth experiments, unites into one viscid mass; but still susceptible of division by strong shaking. After twenty-four hours the copal exhibits a firm consistence, and by a hard body may be reduced to coarse powder, even in the liquid. A digestion of ten days communicates to the liquid a beautiful gold colour, and increases its specific gravity six grains. The ethereous mixture has more action on copal of two fusions than on that which has been subjected to one liquefaction; but this superiority is not so great as to admit of its application for making copal varnish. It is probable that it would have a more decided advantage over every other resin employed for alcoholic varnish, as is indicated by the mixture of copal and sandarac in the sixth experiment. These ethereous mixtures may be more happily applied with resins exceedingly soluble in alcohol, and by these means concur to the improvement of the varnishes of the first and second genera.

The balneum mariæ occasioned no great change in the state of the solution, the specific gravity of which by this second process was increased only $1\frac{3}{4}$ grain, forming by this increase a total of $9\frac{3}{4}$ grains.

Experiment XII.

C. Moulot, in the *Journal de la Société de Medecine à Paris*, gives a process for dissolving copal entirely in alcohol. Nothing is necessary but to project the pulverized copal by pinches into the alcohol saturated with camphor. The opinion which I conceived from my own researches on this matter induced me to repeat the experiment, and to employ for this operation copal without any preparation, and that of one fusion.

The solution of the camphor was effected in alcohol exposed for three days to the sun in a vessel closed with a cork stopper. The specific gravity of the alcohol decanted from off the remaining camphor appeared by my areometer to be thirty grains heavier than that of the alcohol employed.

I subjected, at four different times, forty-eight grains of common copal in powder to an ounce and a half of this alcohol saturated with camphor. I each time stirred the mixture to divide the copal, which appeared to me disposed to unite into a mass. In this state of division the alcohol assumes a milky appearance; but by rest there is formed a thin sediment, which, under the form of fine snow, occupies the half of the liquid. The part of the latter which floats over the deposit shows no alteration, either in its colour or its limpidity. I continued to shake the vessel for six days successively, in order to facilitate the solution; but without any apparent success, even under the influence of the sun during some hours every day. The liquor being then filtered, I was able to observe its specific gravity. It was inferior by one grain to that of the alcohol employed.

The sediment readily detached itself from the paper by pouring pure alcohol over it; but it was separated in the form of lumps, which I was able to unite into one mass by kneading them in alcohol. This operation, which laid hold of a part of the camphor united to the copal, restored to the latter its former state of dryness. There was, indeed, separated a fine powder, a part of which united itself to the small kneaded mass; while another remained suspended in the liquid, which assumed a milky colour. After this washing, the small mass of copal, in regard to consistence and colour, had a great resemblance to the glutinous matter separated from farina by washing it in water. In this state it weighed fifty-six grains, which was eight grains more than the weight of the copal employed. But it still contained camphor and alcohol, which concurred to produce that state of pliability which it still retained. By some hours' exposure to the sun it was dried to the centre: it then weighed no more than thirty-seven grains. On adding to this quantity four grains of the copal precipitated from the remaining solution, which I had mixed with the alcohol of the washings, and about two grains of the same matter lost on the filter, I found a deficit of 5 grains of copal, which remained in the state of solution, and which could be precipitated by pouring pure alcohol into the liquid, which contained the solution and the alcohol of the washing.

Hence the *maximum* of the solution of copal, by C. Moulot's method, may consume at most from eight to ten grains of this matter, with the quantity already mentioned of camphorated alcohol.

Before the liquor was filtered I spread out some of it on a piece of wood prepared with gum water. The evaporation of the liquid caused to be deposited a slight stratum, white and as it were mealy, which was removed by the least friction. This was camphor mixed with a little divided copal, which rendered it somewhat rough to the touch.

Experiment XIII.

The above processes were repeated with the same doses, and under the same circumstances, on copal of one fusion.

On the first projection of the powder the liquid acquired an ambery colour; but the powder fell to the bottom of the vessel, where it assumed a viscid and soft consistence. Two days after, however, the decrease observed in its volume indicated a more extensive solution than in the preceding experiment. The camphorated alcohol had enough of colour, and yet it retained its limpidity.

After being infused six hours in the sun, mere decantation was sufficient to separate the liquid from the soft matter exhibited by the copal; and my areometer indicated an increase of six grains, on comparing its present specific gravity with that of the camphorated alcohol.

I tried, but without success, to knead the soft matter which covered the bottom of the vessel. I therefore contented myself with washing it, to remove the camphor which gave it that consistence. The alcohol employed in washing it came off clear, and after reposing for some seconds, the copal had resumed its former dryness. After its complete desiccation it was found to be reduced to twenty-nine grains, estimating at two grains the loss occasioned by the parts which adhered to the sides of the vessel, and to the small spatula employed to detach it. The nineteen grains, then, which formed the deficit, had passed into the camphorated liquid.

Though this circumstance proves that copal, prepared according to my method, is superior, by its soluble property, to unprepared copal, the result is not yet sufficient to constitute a varnish.

The application of a stratum of this solution to wood, prepared with gum, was attended with the inconvenience already mentioned; the only difference was, that the wood exhibited a light brown tint.

I confine myself to this plain account of the process indicated by C. Moulot. My regret is, that I had not time to repeat these experiments on different varieties of copal, rather with a view of observing the differences which might occur in its union with camphor, than with a hope of composing a varnish by this method.

The principal object of this new labour was to ascertain the utility of a mixture of copal with other resins, more soluble than in alcohol, and not to add new formulæ to the first two genera of our varnishes. Though the greater part of the results I have here given are unsatisfactory, there are some of them which seem to authorize, and even to require, the addition of copal to certain compositions with alcohol.

The well-conducted digestion or maceration of copal prepared by a first liquefaction with pounded glass, as in the fourth experiment, or of copal treated over the fire with a solid resin, such as sandarac, (Exp. VI.) or of mixtures of other resins, the solubility of which in alcohol is confirmed, may still add to the durability of the varnishes of the first and second genera. One might even be induced to believe that the tinctures formed in the fourth, sixth, and ninth experiments, applied to one of our copal varnishes with essence well dried, would unite to the advantage of destroying the disagreeable odour of the essence, that of adding even to the substance of the copal, if those genera of varnish which abandon their odour more readily than fat varnishes with essence had need of such a palliative.

But no circumstance seems to show that the use of camphor as an intermediate substance is advantageous in the composition of copal varnishes with alcohol. The sixth experiment exhibits some results which announce a more extensive solution than by the other processes. However, if we compare these trials with those already mentioned, we shall soon be stopped by uncertainty in regard to the extent of the result, and particularly by the inconvenience arising from the volatile nature of the camphor. This inconvenience is not an imaginary evil; it is sufficiently proved by the state of the small flexible masses of the copal, which too slow desiccation renders spongy and pulverulent. In a word, if such a composition had not against it the strong and disagreeable odour it emits, and the slow desiccation of the varnish, one might be stopped by the certainty of seeing the varnish insensibly lose its lustre by the slow volatilization of the camphor; split, or exhibit a mealy and spongy surface, and abandon all the characters which belong even to the most common varnishes.

These experiments discover also another point of utility. They throw light on the course proper to be followed in the preparation of copal varnishes with alcohol, whether it be employed alone or mixed with similar substances, and on the superiority of simple digestion to infusions exposed to too ardent a sun, or to a balneum mariæ. The action of digestion is slow; but it must produce more effect on a substance the parts of which remain divided, than rapid infusion of the same substance, which the action of the caloric (heat) reduces to a mass. Besides, the second and third experiments prove, in the most convincing manner, that what is obtained by long maceration is often destroyed by strong infusion in a balneum mariæ.

But other experiments prove also that, if long maceration seems to be proper in many cases in the composition of alcoholic varnishes, and particularly of those which have copal for their basis, the case is not the same in regard to copal varnish made with essence of turpentine. Infusion in a balneum mariæ completes, in two minutes, a solution which could not be effected in several hours by maceration, and even motion. A varnish of the first quality, and of an excellent consistence, which requires neitheir clarification nor filtration, and which possesses the property of drying speedily, will at length be obtained. If copal, previously liquefied according to my method, be used for the composition of this varnish, no preparation of the essence will be necessary. That least proper for becoming charged with copal can, in this case, take up 1½ gros, and even more than two gros of the copal which has undergone two liquefactions. But in the latter case the varnish is a little coloured.

After the opinion I have given in regard to the employment of camphor, which is supposed to be very useful for completing the solution of copal in alcohol, I ought to abstain from all further reflections on the method proposed by C. Moulot. In this respect I refer to the results of the twelfth and thirteenth experiments; but I think it indispensably necessary here to call the reader's attention to the consequences which might be deduced from a comparison of the state of the consistence of a solution of copal in essence with that of the same solution in alcohol, and from remarking what real singularity these two solutions exhibit in their specific gravity.

We have seen, in treating on the method of making in a few minutes turpentine copal varnish, that though this varnish had a very oily consistence, its specific gravity was increased only fifteen grains per measured ounce, according to my areometer. We have seen, on the other hand, that the highly-charged tincture of copal of the fourth and ninth experiments, and that of the camphorated copal of the fifth experiment, retain the fluidity by which pure alcohol is characterized, though their specific gravity, and particularly that of the latter, approached very near to the specific gravity of varnish composed with essence. To these two results I shall add two other observations, made on a highly charged tincture of gum anima, the specific gravity of which had increased fourteen grains, according to my areometer; and on a tincture of amber, the increase of which was seventeen grains, without the state of the fluidity of the alcohol appearing in either of these two cases to be lessened.

Such effects can arise only from the state of penetration or intimate union of the moleculæ of the substances in contact; and consequently must relate to their particular nature. It may, therefore, be readily conceived, that this union is more striking and more perfect between alcohol presented to amber, or to copal, or to gum anima, than between these resins and essence of turpentine; since two ounces in absolute weight of this essence, which we know hold in solution nearly three gros of copal, weigh only fifteen grains, of the seven gros and twenty-six grains expressed by the specific gravity ascertained by an areometer, the capacity of which is an ounce of distilled water at the temperature of 59° of Fahrenheit.

This chemical state of resins, in different liquids which serve for the composition of varnishes, is truly singular, and in this particular point of view deserves to be further examined. But what proves in a very convincing manner that essence is better suited than alcohol to the composition of varnish, is, that one stratum of my turpentine varnish spread over wood, without any preparation, renders the surface exceedingly brilliant, by depositing on it a very durable glazing; while three strata of the different tinctures of copal are required to produce upon wood the appearances of varnish.

Alcohol, then, does not seem to be suited to dry and solid substances, such as copal and amber, which are besides so different from common resins by their other properties. All hope, therefore, of composing with it an alcoholic varnish must be renounced, if we banish from the composition every intermediate body capable of serving as a bond of union to the divided parts of these two substances, which the alcohol abandons by the effect of evaporation*.

It is known, in general, that alcoholic varnishes are the most delicate, and that they would have still less consistence should those by whom they are made neglect to introduce into the composition of them as an essential ingredient a viscid and tenacious substance, such as turpentine, or some other of the same kind, which acquires modifications either naturally or by the effects of art. If this remark is well founded in the case of common varnishes of the first and second ge-

* I composed very good varnish with the tincture of copal furnished by the fourth experiment, by adding mastic and one-eighth of turpentine, according to the quantity of the tincture; but though this varnish contained enough of copal, it could not be considered as pure copal varnish made with alcohol.

nera, ought it not to excite doubt also in regard to qualities assigned, without any foundation, to simple spirituous tinctures of copal and of amber, when matters such as turpentine, or any other capable of diminishing the dryness of these two substances, are banished from the composition of them? But by admitting these necessary correctives we approach the varnishes of the fourth genus; and in this case it is more convenient, and even more useful, to make the copal varnish with turpentine, following the prescription indicated. In general, varnishes with essence hold a proper medium between those which might be composed with alcohol and copal, and those which admit the use of drying oils, as in our fifth genus of varnishes.

No theory is good unless founded on experience. From experience, therefore, I think myself authorized to assert, that the successive application of alcohol charged with copal or amber, without a mixture of turpentine or other resins, cannot exhibit the qualities of a superior varnish. The spirituous liquid abandons soon after by evaporation the substance it had appropriated to itself, and leaves it under an almost pulverulent form, which the least friction whitens and causes to disappear. There is only one case capable of moderating this effect, which is indeed certain: it is when colouring parts are mixed with this kind of varnish. I have as yet observed only one fact, which proves that amber varnish composed with alcohol is capable of glazing any surface. I observed it at the mouth of a phial containing highly charged tincture of amber, employed for daily use. The successive accumulation of the resinous part may alone serve to explain this fact. Essence has a great advantage over alcohol in the composition of varnishes; as it concurs by its own substance to the connection of the resinous parts of which they are constituted. Alcohol, on the other hand, is entirely dissipated. Varnishes with essence, therefore, are more pliable, more brilliant, and more durable, than those made with alcohol. I have also observed in these new trials, anomalies in the common properties of copal, which embarrass those who employ it, and which are calculated to involve in uncertainty every thing we know, and every thing which can be announced as new in regard to this singular substance. I have already spoken of them in my experiments which follow the article on the varnish No. XXI.

The copal sold in the shops exhibits various shades of colour, and the case with it is different from that of all the resins applied to varnishes, in which the varied tints they may acquire do not seem to affect their chemical qualities, or to announce new ones contrary to those which are the most apparent. There are some specimens of it which might be confounded with the purest gum arabic, that is to say, absolutely colourless, and exceedingly transparent. Other morsels have a very light lemon colour, which in other pieces appears more ambery, with the transparence and splendour of the most beautiful topaz. In the last place, this colour is often darker, and sometimes brown and very dull.

The numerous experiments I was obliged to make enabled me to take advantage of these different varieties of copal, and to observe that the property of solubility sought for in this substance is not sufficiently stable to be in any measure distinguished by certain exterior signs. It depends, no doubt, on many circumstances still unknown, and determined by the age of the tree which furnishes it; by its local exposure, by the nature of the soil, and by the influence of its native atmosphere: I have, however, had the satisfaction of convincing myself that the copal proper, in general, for making varnish is that which one might be tempted to reject on account of its colour, and of a certain dull aspect disgusting to the artist, who in this case attends too much to the extreme purity of the substances employed in the preparation of transparent varnishes. The colour of copal, however, may sometimes be consulted to enable one to judge of its degree of solubility, especially in all cases of a charged composition, such as that of the fifth genus of varnishes. This assertion is supported by a great number of facts: but it does not establish a general rule; for I have seen copal exceedingly pure, and almost colourless, dissolve as speedily in ether as copal of a bright topaz colour. I have in my collection several pieces of this kind: other specimens extend themselves in that liquid under the form of very fine snow, which yields to all the motions communicated to the vessel, but which resists a more extensive action on the part of ether.

It was copal of a similar kind, but somewhat more coloured, which I employed for these latter experiments. This resistance, however, is overcome by the preparation here recommended, that is to say, liquefaction in the furnace above described; but when presented to the essence, the ether or alcohol, it must be in powder. When I made choice of this copal, I had reason to hope that the results I should obtain from it would be still more extensive, on repeating the same processes with copal better fitted for the composition of varnish.

FIFTH GENUS.

FAT VARNISHES.

Preliminary observations.

The varnishes of this genus are the most durable, but they are the slowest in drying. They are destined for objects exposed to friction, or to shocks from hard bodies; and are employed, in a particular manner, for the decoration of carriages. They are applied to wood, to iron, to brass, and to copper: they are used also for painting waiters, Argand's lamps, teapots, and other utensils of the same kind which are in daily use.

The matters which enter into the composition of these varnishes are few in number. The artist confines his means to the solution of copal and of amber in essential oils, in prepared linseed oil, and in nut oil or oil of poppies. In the first experiments on balloons, caoutchouc or elastic resin was added to these substances. We may place in the last rank that common kind of varnish with which ships and other vessels are daubed over.

In this case the processes are not confined to simple infusions. The dry and solid nature of the substances destined to serve as the basis of these varnishes requires other means, and a higher temperature. Though these substances have properties common to them all, they possess others which are peculiar to each of them. It is these differences which induce artists not to confound them, or not to employ them collectively in the composition of their varnishes.

Copal, indeed, presents less resistance to liquefaction, at a given temperature, than amber. It is more susceptible of decomposition; and the varnish resulting from the mixture of it with any oil is less coloured, and not so dark as that obtained from a mixture of amber with the same oil. If copal were mixed with amber in the same operation, it would in a great measure be destroyed before the latter were in a state of liquefaction. There is a fat varnish then with copal, and another with amber. To these I shall add that of caoutchouc or elastic resin.

Though the doses indicated, in my different formulæ, for this fifth genus of varnishes have been proved, the last portions of the copal, and particularly of the amber, must not be melted if the varnish be required as little coloured as possible. The portions of the amber which have escaped liquefaction may be easily separated by a sieve, or by deposition. Copal presents less resistance, and, when employed in small fragments, is soon liquefied. In other respects I must recommend the method indicated at the end of the description of my furnace; because the matter, when once liquefied, escapes from the burning atmosphere, the continued influence of which would have a prejudicial effect on the nature of the substance, and consequently hurt the solidity of the varnish.

First species. Extracted from Watin's work.

No. XXIII.

Take Picked copal 16 ounces.
Prepared linseed oil, or oil of pinks, 8 ounces.
Essence of turpentine 16 ounces.

Liquefy the copal in a matrass over a common fire, and then add the linseed oil, or oil of pinks, in a state of ebullition: when these matters are incorporated take the matrass from the fire, stir the matter till the greatest heat has subsided, and then add the essence of turpentine warm. Strain the whole, while still warm, through a piece of linen, and put the varnish into a wide-mouthed bottle. Time contributes towards its clarification; and in this manner it acquires better qualities.

In general, there is much advantage in not employing too violent a heat. The varnish by these means succeeds better, and acquires less colour. If it afterwards becomes too thick, add a little warm essence, that the mixture may take place more speedily. It was in this manner that the celebrated Martin composed his beautiful white fat varnishes.

Second species of the same genus, employed in the manufactories of Geneva for watch-cases, in imitation of tortoise-shell.

No. XXIV.

Take Copal of an amber colour 6 ounces.
Venice turpentine $1\frac{1}{2}$ ounce.
Prepared linseed oil 24 ounces.
Essence of turpentine 6 ounces.

It is customary to place the turpentine over the copal, reduced to small fragments, in the bottom of an earthen or metal vessel, or in a matrass exposed to such a heat as to liquefy the copal: but it is more advantageous to liquefy the latter alone, to add the oil in a state of ebullition, then the turpentine liquefied, and, in the last place, the essence. If the varnish is too thick, some essence may be added. The latter liquor is a regulator for the consistence in the hands of the artist.

The dose of oil, in this case, appears to me to be too great: eighteen ounces would be sufficient. This varnish is durable and transparent; but it dries with difficulty. In general a stove is employed to hasten the desiccation: it is susceptible of a fine polish.

Third species. Amber varnish.

No. XXV.

Take Amber, coarsely pounded, 16 ounces.
Venice turpentine, or gum lac, 2 ounces.
Prepared linseed oil 10 ounces.
Essence of turpentine 15 or 16 ounces.

The circumstances of the process are the same as those prescribed for the preparation of the copal varnish, No. XXI.

Remarks.

This varnish was formerly much used; but it has given place, in part, to that of copal, which is preferred on account of its being less coloured. Watin introduces more essence and less linseed oil: experience and long practice are the only authority on which I recommend the adoption of the present formula.

Copal and amber are the two dry substances applicable to the composition of varnish, which are the most difficult to be brought to the liquid state. They require the direct application of heat.

A varnish might, indeed, be composed, according to the practice of some artists, by treating simultaneously amber and copal; but the difference observed in the phænomena they exhibit in the fire ought to make this method be rejected. The copal is, in part, decomposed before the amber has completely abandoned its consistence. Besides, copal varnish without mixture is of an amber colour and very transparent.

When mixed with amber the varnish is of a very dark brown colour.

Setting out from this fact, the mixture of turpentine is more proper with linseed oil than with amber; and the oil ought to be boiling when presented to the amber in a complete state of liquefaction. But this precaution is still not sufficient, if it be required, as ought to be the case, that the three substances in contact should unite in a speedy and intimate manner. If the whole quantity of oil added to the turpentine were poured in at one time, a portion of the amber would be precipitated. This projection ought to be effected at several times, taking care to facilitate the contact by stirring the mixture with an iron rod. It will even be proper to bring the mixed matter to a state of ebullition before it be taken from the fire.

Some artists do not wait till the whole of the amber is in a complete state of liquefaction before they add the oil: they are satisfied with liquefying a part; and they then separate the fragments of the amber which have not been melted. By this method the varnish is less coloured; but it requires more amber or copal than is prescribed in my formulæ.

Sometimes one is stopped by the fear of not finding vessels capable of standing the whole operation. A cast-iron pot will obviate this inconvenience, and ought to be preferred to vessels of earthenware, which either crack or split. When porous they are soon penetrated by the varnish: besides, they can be employed only once; the second varnish made in them would acquire too dark a colour. A cast-iron pot has this advantage also over pottery, that it can be cleaned, while warm, to remove the portions of the old varnish, which would be coloured by the fire employed for a new composition.

Before I proceed to the composition of the other varnishes which belong to this last genus, it may be of use to take a view of the processes I have followed in treating copal in a manner entirely new, and to apply them to amber. By adhering closely to the formulæ established by usage and long experience, my principal intention was to enable artists to compare them with the simple method which I have substituted in their stead. I should form an erroneous opinion of artists, and particularly of those who are loth to sacrifice old habits, were I to believe them capable of abandoning, without opposition, the favourable idea they have of the nature of amber, and of the superiority they ascribe to it, but without sufficient reason, over copal. In general, they are much disposed to believe that the character of solidity by which it is distinguished, when considered in its natural state, and which appears to render it superior to copal, is maintained in its mixture with drying oils, and that it becomes the principle of the consistence of the varnishes of which it constitutes the principal base.

One, however, may be easily convinced, on comparing the results exhibited by these two singular substances, in the kind of analysis to which they are subjected, that the one which, when it appears under its natural characters, seems to have a superiority over the other, resigns it to the other when it has been brought to the necessary degree of liquefaction, before it be mixed with oils in the process of making varnish. What is then considered as an essential quality in amber examined in regard to its constituent parts, becomes prejudicial to it when applied to the composition of varnish; because the greater resistance it opposes to the influence of caloric, at the time even of its liquefaction, alters its principles in a higher degree than is the case in the liquefaction of copal. The latter indeed requires less heat, and passes more readily to the state of liquefaction. The following experiment will give some weight to this assertion:

Preparation of amber according to my new process already described.

Five ounces of amber, of a very dark orange colour, but transparent, and in pieces of the size of a small nut*, treated in my melting furnace, required a half more time than copal before it exhibited the first indications of liquefaction, the fire in both cases being subjected to the same regulation. A great deal of pretty thick oil, and which always retained that consistence, was disengaged. It envelops in such a manner the parts which acquire solidity by cooling, that it is difficult to separate it by immersion in tepid water, and by means of blotting paper. However, by exposing the

* The amber to be liquefied must not be employed in pieces too large, or in coarse powder, because it soon forms a mass, and does not run so freely. It is indeed very slow, and furnishes more fluid oil than in the present case: the varnishes also are more coloured.

amber to the air for some days, it becomes so solid that the laminæ it forms may be broken between the fingers. In this state these laminæ have the transparency and colour of the hyacinth. The amber is obtained under this form, when care is taken to bring it to the edge of the vessel, filled with water, into which it flows, by means of a hook, or pallet-knife bent at the extremity. This matter, which is pretty dry in appearance, when pounded in a mortar forms itself into a small mass, which readily crumbles to pieces. It is indebted for this flexible quality only to a portion of the free oil, which covers the surface of it under the form of a varnish.

When this consistence is compared with that assumed by copal under similar circumstances, one may readily be convinced that the latter, the consistence of which is drier and even pulverulent, is preferable to amber for the preparation of varnish. This opinion will even be maintained in favour of copal of a second fusion, the alteration of which is more observed in the colour it acquires than in its proper substance. This result, which is sufficiently confirmed, induces me to believe that the process hitherto employed for the composition of fat amber varnish, and in which the amber undergoes a still greater alteration, only adds a thick oil to that presented to it; and that the varnish thence resulting can have no superiority over copal varnish, composed according to my principles; since nothing announces that the consistence, observed in the copal before its mixture, can be weakened when it yields to the laws of solution.

In considering, besides, the state of alteration which amber experiences in the common processes, and the degree of heat which these processes require, it may still be believed that the quantity of it which passes into the varnish amounts scarcely to one half of the whole. One may suppose that a portion reduced to the state of oil readily passes into the oil, and that it disposes towards the same result another portion of amber less altered, and nearer to its state of consistence. The rest is composed of the portion of the amber destroyed, and of that which resisted liquefaction. It is the carbonaceous part suspended in the mixture which occasions the alteration in the colour of the liquid, and the thick deposit which is formed some time after.

The unnatural state of amber in all the forced compositions which constitute this last genus of varnish, is very proper for pointing out the advantages of the formulæ given for my fourth genus, and to dissipate the least traces of the superiority ascribed, without any reason, to amber over copal. By subjecting amber to the processes so happily applied to copal, my intention therefore is rather to gratify the taste of the old artists, who are led away by habit, than to maintain any doubts on the place which copal and amber ought to occupy in the composition of varnishes, in regard to the intrinsic qualities they are capable of communicating to them. Essence furnishes enough of its substance to constitute, and particularly with copal, durable compositions. By giving a preference to the varnishes of the fourth genus, the artist satisfies, at the same time, his own knowledge, and the anxiety of those who employ him. By the speedy desiccation of varnishes of this genus he is soon enabled to complete the labour of polishing, which is always tedious when varnishes of the fifth genus are employed.

Amber varnish with essence of turpentine.

Take Amber, liquefied according to my process, and separated from the oily portions which alter its consistence, 6 or 7 ounces.
Common essence of turpentine 24 ounces.

Reduce the amber to powder, and if the operation of pounding forms it into a paste, break it with your fingers: then mix it with the essence, and treat the whole in a balneum mariæ. It will speedily dissolve, and the essence will take up at least a fourth part of its weight of the prepared amber.

The varnish which results from it is more coloured than that made with copal and turpentine; but it readily clarifies, even without filtering it through cotton. It may readily be conceived that this varnish forms a part of those of the fourth genus.

When one coating of it is applied to white smooth wood, but without any preparation, it forms a very pure and very durable glazing, which speedily dries, but slower than copal varnish. It appears to me to be superior to highly coloured varnishes, which admit the addition of oil in common compositions, and which to be thoroughly dried require the use of a stove.

As copal and amber must be liquefied before they are mixed with drying oils, which serve as excipients to fat varnishes, it may be advantageous to follow my process under such circumstances as may seem to favour the preference given to drying oils over essence of turpentine. The following formula was attended with complete success.

Fourth species. Fat amber or copal varnish.

No. XXVI.

Take Amber or copal of one fusion 4 ounces.
Essence of turpentine } of each 10 ounces.
Drying linseed oil }

Put the whole into a pretty large matrass, and expose it to the heat of a balneum mariæ, or move it over the surface of an uncovered chaffing-dish, but without flame, and at the distance from it of two or three inches. When the solution is completed, add still a little copal or amber to saturate the liquid; then pour the whole on a filter prepared with cotton, and leave it to clarify by rest. If the varnish is too thick, add a little warm essence, to prevent the separation of any of the amber.

This varnish is coloured, but far less so than those composed by the usual method. When spread over white wood, without any preparation, it forms a solid glazing, and communicates a slight tint to the wood.

If you are desirous of charging this varnish with more copal or prepared amber, the liquid must be composed of two parts of essence for one of oil *.

The whole of the processes here given, and which may be applied to the composition of varnishes of the fourth and fifth genera, leave no doubt in regard to the course which will be followed by artists who know how to make use of the advantages they offer, and to compare them with each other. I am persuaded that they will give a decided preference to turpentine varnishes treated according to my method, and that in future they will confine fat varnishes to common objects; if they are still retained, notwithstanding the defects with which, it is well known, they are attended. I shall conclude this chapter with an account of three compositions which may be esteemed by some artists, but I must recommend the use of amber, prepared according to the method which I have already described.

* Amber prepared according to my method suffers itself to be laid hold of by the alcohol, to which it communicates a lemon colour. What distinguishes it from copal is, that it retains its pulverulent form in the heat used for infusion in a balneum mariæ. The tincture resulting from this mixture is attended with no greater advantage to varnishes than those extracted from copal.

Ether exercises on it a more striking action: it readily attacks it, and can take up a gros of it. The varnish it produces is coloured. When deposited on wood dipped in oil, and afterwards well rubbed with a view to render the dissipation of the ether slower, it left a solid coating of varnish with a beautiful gold tint: when spread over wood not immersed in oil, it left a coating which resembled pale gold.

Fifth species of the same genus. Fat varnish of a gold colour.

No. XXVII.

Take Amber, prepared according to my method, 8 ounces.
Gum lac 2 ounces.
Drying linseed oil 8 ounces.
Essence of turpentine 16 ounces.

Dissolve separately the gum lac; and then add the amber, prepared and pulverized, with the linseed oil and essence very warm. When the whole has lost a part of its heat, mix in relative proportions tinctures of anatto, of terra merita, gum guttæ, and dragon's blood, as mentioned page 142. This varnish, when applied to white metals, gives them a gold colour.

*Sixth species of the same genus. Fat varnish, which may serve as a mordant to gold, and at the same time to dark colours *.*

No. XXVIII.

Take Boiled linseed oil 16 ounces.
Venice turpentine 8 ounces.
Naples yellow 5 ounces.

Heat the oil with the turpentine, and mix the Naples yellow pulverized.

* The varnish No. XVI, of the third genus, that is to say, with essence, is also a mordant.

Remarks.

Naples yellow is an oxide of lead, the composition of which will be given when we come to treat of colouring substances*. It is substituted here for resins, on account of its drying quality, and in particular of its colour, which resembles that of gold. Great use is made of this varnish in applying gold leaf.

The yellow, however, may be omitted when this species of varnish is to be applied to solid and coloured coverings. In this case an ounce of litharge to each pound of composition may be substituted in its stead, without this mixture doing any injury to the colour which is to constitute the ground (*la teinte dure*).

There is still another species of varnish, which, like the above, might form a part of those of the third genus, if the matter which serves as the basis of it did not require a drying oil to be employed: it is that of caoutchouc.

Sixth species of the same genus. Caoutchouc varnish.

No. XXIX.

Take Caoutchouc or elastic resin	of each 16 ounces.
Boiled linseed oil - -	
Essence of turpentine -	

Cut the caoutchouc into thin slips, and put them into a matrass placed in a very hot sand bath. When the matter is liquefied, add the linseed oil in a state of

* See Part II. Chap. I.

ebullition, and then the essence warm. When the varnish has lost a great part of its heat, ſtrain it through a piece of linen, and preserve it in a wide-mouthed bottle. This varnish dries very slowly; a fault which is owing to the peculiar nature of the caoutchouc.

Remarks.

The solution of this singular substance is not confined to essential and fat oils. Macquer applied ether to it with success*; but the processes he indicates do not always answer, and cannot form a part of those which we are desirous to place within the reach of the public in general.

In repeating these experiments, I found that the union of caoutchouc and ether did not manifest itself till the volume of that fluid was reduced one half by the effect of evaporation. It appears therefore that ether exercises a better action on this substance according as it has less tenacity, and as it approaches more to the oily nature. In consequence of this principle, the best rectified ether refuses to form any kind of union with caoutchouc. This, perhaps, is the chemical reason proper to be adduced in order to account for the difference between the experiments of Macquer and those of Berniard†.

The invention of air balloons led to the idea of applying caoutchouc to the composition of varnish. It was necessary to have a varnish which should unite

* See Mémoires de l'Academie des Sciences, 1768.

† See the article *Caoutchouc.*

great pliability and consistence. No varnish seemed capable of corresponding to these views except that of caoutchouc; but the desiccation of it is exceedingly tedious.

The formula which I present is the same as that indicated in the *Journal de Physique* for April 1781. I only modify the process by omitting the long ebullition of the essence over the caoutchouc. By my method the solution is speedier, and less of the essence is lost.

I cannot conclude this chapter without remarking, that there is even another species of varnish belonging to this last genus, the use of which is very extensive; and which, no doubt, would occupy the first rank, were it considered in regard to its utility: it is that which results from a mixture of tar, black pitch, rosin, tallow, and sometimes even sulphur, and which is employed for covering the outside of ships, boats, and barges. This varnish preserves them from the influence of the water, retards their destruction, and prevents the velocity of the vessel from being lessened by the additional weight which would be communicated to it if the water were imbibed by the wood. This varnish then contributes as much to the celerity of the vessel as to its preservation.

CHAPTER IV.

General observations and precepts respecting the preparation of varnish on a large scale. Description of an alembic with a balneum mariæ, the use of which prevents all those accidents that frequently accompany the making of varnish.

The division I have made of varnishes into five genera, each sub-divided into its species or varieties of composition, rendered it necessary for me to place after each formula the remarks that seemed peculiarly applicable to it. There are others, however, of a more general nature, which seem to belong to the whole art, and which ought to be given by themselves.

All the arts have had their state of infancy. The progress of them has been the result of repeated trials, and sometimes of errors; but, for the most part, they are extended by accident. It is on these frail and uncertain bases that those arts which relate to the most necessary objects have been established. A long repetition of the same processes has at length thrown light on their progress; and in this manner the first elements of them have been acquired.

That of the varnisher could not speedily attain to its highest degree of perfection. Its origin depended on that of public wealth, and on the extinction of those wars which covered Europe with ruins: it depended on the extension of commerce, which increases the enjoyments of life, inspires a taste for superfluities, and multiplies our wants. An industrious people, attached to the arts, and confined to the eastern extremity of Asia, furnished us with the models. The European industry, and particularly that of France, acquired a stimulus; it invented combinations; mixtures were multiplied; and the results, though still imperfect, afforded sufficient encouragement to artists. New attempts opened a more successful path; the principles of the art were discovered, and these were followed by formulæ and descriptions; critical examination determined the choice of them; and the art was at length established on a solid basis.

All resinous or gummo-resinous substances are the only essential bases of varnishes. Every spirituous liquor, resulting from vinous fermentation, and freed by rectification from its superabundance of foreign water, such as pure alcohol (spirit of wine); every essential oil extracted from plants by distillation; and even every fixed or fat oil, obtained from certain fruits by contusion or expression, are the only matters which can be employed as an excipient or vehicle to the resinous or gummo-resinous substances destined for varnishes.

Perfect transparency, and even limpidity and lustre, are, in the last result, the essential qualities in the composition of varnish. There are others, however, equally important, such as those of drying speedily, and giving solidity to the resinous stratum which serves as a glazing to the bodies it covers. A composition of this kind must at the same time be colourless, in order that it may not weaken or disfigure the tints of the colours, which it ought on the contrary to call forth in their full brightness, by preserving them from the influence of the air and of moisture.

From this correct view it may readily be conceived, that it is not sufficient that a substance should be of a resinous nature, pure and without any mixture of foreign bodies, and that it should be entirely soluble in the liquid intended for the composition of varnish: to be entitled to a place among those destined for this purpose by use and experience, it must also have very little colour.

There are many substances, indeed, which are rejected on account of their softish consistence, such as sagapenum, galbanum, &c. as well as of their colour, which would spoil that of the compositions. This would be the case with the resins called bdellium, guiacum, ivy gum, gum ammoniac, and olibanum, though the last two dissolve entirely in alcohol. Some of these substances did not escape the notice of those who first made experiments in regard to varnishes; but they soon discovered the inconveniences with which they were attended.

The circle, therefore, is very much limited; and it might still be confined within narrower bounds, without doing much injury to the art. Gum sandarac, employed formerly by the Arabs for this purpose, was the only matter which seemed likely to answer the proposed end. It is easily prepared, and possesses lustre; but it is attended with the disadvantage of a little dryness, which however may be corrected. On account of the preference given to it over other resinous products, and the effects it produces, it has been distinguished by the name of *vernix*.

Turpentine, and all the modifications of it by the effect of evaporation; mastic, which has more solidity than sandarac; gum anima, and gum elemi, gum lac, and copal, compose nearly the catalogue of the matters which are employed for the composition of drying varnishes, or those made with alcohol. The extreme dryness of some of them is corrected by uniting them with others which are less dry, and which still retain a portion of essential balsamic oil, such as gum elemi, gum anima, camphor, and turpentine. The same effect is produced also by substituting instead of alcohol a less dry fluid, such as essence of turpentine.

Industry, however, which readily takes advantage of every thing that can answer its purpose, and which excites the desire of the consumer by the variety of the objects it presents to him, has found means to subject the art to modifications, by extending the processes in some peculiar circumstances which seem to favour it. A great step was, no doubt, made by giving to the compositions of varnish lustre, transparency, a drying property, and freeing them from all colour; but when the grand models exhibited by the Chinese trade were exposed to view, this was not sufficient. The use of the European varnishes, in consequence of the nature of the principles of their composition, was limited to dressing-boxes, and other small articles which served for the decoration of apartments. But the spirit of imitation, which in France more than in any other country excites genius and leads to discoveries; the innate taste for novelty, so prevalent among that nation; that continued fickleness, which often condemns to oblivion master-pieces about to be succeeded by others; and that perpetual fluctuation of fashions and inventions, soon became the most active causes which contributed towards the improvement of the arts of luxury.

To the same causes we are indebted for the origin of the art of making boxes and toys of papier maché covered with varnish; that of gilt leather, which the national fickleness seems to have banished to England; that of coach-making, which laid painting of every kind under contribution. All these arts called in to their assistance that of the varnisher, and gave to it a very great extent. Hence the discovery of coloured, changing varnishes; of very durable varnishes, in the composition of which the artist has been able to overcome the resistance opposed by copal and amber to their usual solvents: hence also the use of resinous colouring substances; such as terra merita, gum guttæ, dragon's blood, saffron, sandal wood, anatto and others.

Experience has set bounds to the number of the liquids proper for serving as vehicles in the composition of varnish. The nature of alcohol was suited to light, drying, and colourless compositions, when artists were desirous to correct the strong odour which accompanies most varnishes.

In examining the essential oils, artists must have first distinguished those which on account of their lightness seemed to exhibit intermediate qualities between alcohol and oils of the greatest consistence: hence the use of essence of turpentine, oil of spike, and oil of lavender.

Essence of turpentine gives to varnish more body than alcohol: it might indeed be substituted in all cases for alcohol, if the strong odour it emits were not, to some persons, a cause for rejecting it. For varnishes, however, destined to be applied to ceilings, wainscoting, and furniture, it is far superior; because it renders them equally brilliant, and gives them more durability. During the summer, in particular, this odour is soon destroyed; and if the artist takes care to employ an alcohol varnish for the last stratum or glazing, there will be no odour at all.

The use of essential oil of lavender is more applicable to delicate oil painting than to the art of the varnisher. Though naturally drier, next to essence, than essential oils, it is still too fat and unctuous for varnishes. It may, however, be introduced in small doses in the composition of varnishes made with alcohol and essence of turpentine, when it is necessary to lessen their drying quality, or when metallic colours are used in the state of pure oxides.

The other essential oils known in commerce are either too dear, or too fat, or too much coloured, to form part of the liquors destined for the solution of resins.

The number of the fat or fixed oils useful to the art is as much limited as that of the essential or volatile oils. Oil of white poppy seed, called improperly *oil of pinks*, nut oil, and linseed oil, are the only ones found by experience to be fit for the composition of fat varnishes, when they have undergone preliminary preparations which deprive them of their unctuous quality, and render them drying. Olive oil would answer the purpose of the artist better than nut oil or linseed oil, which are always coloured, if nature, which presents it without much colour, had not communicated to it an unctuous matter, which can be removed only by destroying a part of the oil itself. The case is the same with oil of turnips and oil of hemp seed: and the processes to which the seeds of the beech tree are subjected before the oil is expressed from them, give it a red colour, which renders it unfit for varnish.

To judge, then, from the results alone, varnishes, such as they are exhibited by our five genera, are nothing but solutions of pure resins, or resinous gums, in an appropriate spirituous or oily liquid. Acid liquors, therefore, and alkaline liquors, though the latter have the property of combining with oils and with resins, and of reducing them to the saponaceous state, are in no case endowed with the essential qualities requisite for the composition of varnishes.

The effect of chemical dissolution ought to be distinguished from that of simple solution. The views of the chemist are very different from those of the composer of varnish. The former employs every mean to facilitate the separation of the principles of bodies, that he may examine their intimate and peculiar nature, and reduce them to their greatest state of simplicity, for the purpose of afterwards assigning to them that place which they ought to occupy in the order of created substances. The varnisher, on the other hand, endeavours to preserve the integrity of the substance on which he operates. His means are simple; they act only superficially, by analogy of composition: in a word, they effect merely solutions, the ultimate result of which is confined to extension of the integrant resinous particles. By uniting all the advantages of a mechanical division, as extensive as the object requires, the resinous substances subjected to the action of the agents which the varnisher employs, lose none of the principal characters which render them proper for the composition of varnish; namely, transparency, durability, inflammability, and lustre.

If saline, acid, and alkaline liquors, considered as solvents, are incapable of answering the views of the varnisher; water, a simple substance, without odour and almost without savour, is no less contrary to them. It is the nature of resins to resist its action. Water also has the property of seizing on the alcohol which holds a resin in solution, and of precipitating the latter under the form of a white powder. These effects, which are the more certain as they depend on the particular nature of resins, as well as on invariable chemical properties, require the most scrupulous attention on the part of the artist, in regard to the choice of the alcohol he intends to employ in his compositions. The best brandy, and even alcohol superior to brandy, if inferior to the degree of purity indicated in page 60, are unfit for making varnish. The foreign water which these liquors contain forms an obstacle to the solution of resins; and it precipitates the resinous portion which the spirituous part has been able to dissolve by the aid of caloric (heat). The solution is at any rate turbid, and very little susceptible of clarification. Even if we should suppose that the spirituous part is still powerful enough, considering the quantity, to effect a sufficient though incomplete solution of the resin, the varnish resulting from it would be liable to become mealy, and to crack.

This infallible result may serve, no doubt, to explain the severity with which Watin exclaims against the washing of certain resins in water,---a process recommended by the author of the *Parfait Vernisseur*. But however specious the reasons with which he endeavours to justify his opinion may be, it is no less certain that some resins require to be washed before they can be employed in the composition of varnish. Mastic, sandarac, and even copal itself, which is divided into small portions, &c. require previous washing, which is attended with no kind of inconvenience. The case would be the same with amber, were not this precaution rendered useless by the process to which it is subjected.

These resins are immersed in water after the fine powder has been separated from them by a hair sieve. The fragments and resinous tears are then rubbed between the hands to detach the dust, the lighter parts, and the fragments of bark. These separated parts float on the surface; and, in consequence of their lightness, afford the means of removing them with facility. The washed resin is then spread out on a piece of dry linen cloth, or a hair sieve, which is covered with a sheet of paper; and the whole is exposed to a current of air to dissipate the moisture. Resins washed in this manner, and well dried, are much fitter for the composition of varnishes than those which have not been subjected to the same operation.

A few more precautions are still necessary in composing delicate varnishes, such as those destined for valuable paintings and other objects of luxury. It will be proper to separate the pure resinous tears from those which are stained, and which even are accompanied with portions of the bark of the tree that produced them.

On the necessity of a reduction in the formulæ.

Watin seems to be the first author who was fully sensible of the necessity of reducing the formulæ to a small number of substances. But, notwithstanding the advantage attending this step towards improvement, many things of importance still remain to be done. By prosecuting, for example, a series of experiments on the different resinous substances with alcohol of a known degree of purity, one might form a table of solution, which would be exceedingly useful to the operations of the varnisher; because by knowing the kind of resin about to be treated, and the degree of the purity of his alcohol, he could immediately determine the doses of the substances proper for the intended composition. There are, indeed, some resins more soluble in alcohol than others. This labour, which would save expense, and perhaps time, is worthy of further researches.

The most experienced artists will long be reduced to the necessity of judging by simple approximation, and according to the old formulæ, of the relative quantities of the resinous substances destined for the preparation of varnishes; and, for fear of sacrificing utility to œconomy, they will continue to employ more matter than the object requires.

Of the choice of the matters.

The goodness of varnish depends not only on the choice of the soluble matters, but also on the state of the liquors which are to become charged with them. That oily consistence, which is the first character of a varnish, before it be employed, depends on the nature and purity of the liquid, and on the extent of its power over the resinous substance. A varnish may be of an inferior quality, though the vehicle is charged with as much resin as it can take up. The excellence of alcohol cannot be determined merely by the sight; and for this reason I have enlarged on the means best calculated to serve as a guide to the artist and amateur on this point, which is of the utmost importance.

A knowledge of the nature of essential volatile and fixed oils is much less difficult to be acquired. A skilful eye can easily distinguish the external characters which belong to each of them. Their smell, colour, and a certain degree of connection between the moleculæ, which communicate to them the oily consistence, are unequivocal signs to determine the artist's choice. To these may be added, in cases of uncertainty, the indications we have given in treating of each of them separately.

Such are the guides in which the artist ought to place confidence in regard to the composition of varnish: by these alone he can hope to obtain success. But whatever efforts may be made to produce a *maximum* of solution in the mixture of the matters, he can attain only to a point of saturation proportioned to the nature of the resins, and to the present state of the liquors employed. When people are nice in the choice which they have to make, the principal object is accomplished.

Of the respective doses of the dry and liquid substances employed in the composition of varnish.

The art, however, is still imperfect, if the practical part be confined merely to the choice of the substances. Too great a number of them, as well as too great doses, embarrass the artist in the account which he ought to give to himself of the expected results. Every art founded on a collection of formulæ attains to success only by a very slow progress. To simplify the formulæ, great knowledge and long experience are necessary. One must be able to rise above difficulties, and even criticism, in circumstances when the formulæ compel him to follow habit, or when habit gives weight to formulæ.

By simplifying the compositions, and reducing them to a small number of substances, it was easier to follow the effects, and to discover the causes of them: researches then became less painful and less expensive. A great deal has been done in this respect, and for the most part in a wrong direction; but as long as artists were the only guides and regulators, the success was very doubtful. If the celebrated artist whom I have often quoted was able, by his judicious observations, to make people sensible of the utility and even the necessity of reformation, and of reducing the formulæ to a small number of substances, he did not place the art beyond the need of further advice: more was necessary to be done, by reducing the number of matters, and reducing also the doses.

It is well ascertained, that the best alcohol cannot become charged with more than a third of its weight of the resinous substance, even when the most soluble is chosen. A temperature capable of bringing it to a state of ebullition may give more extent to the solution; but cooling soon restores the equilibrium of saturation. The varnish soon becomes turbid, and the resinous matter which remains in excess at that point of saturation is precipitated, and, under the form of a crystallization, lines the interior sides of the vessel. Some of the formulæ given in the best works still prescribe, in dry matters, a weight equal to two-thirds of that of the excipient. The doses indicated in the different genera of my varnishes are more than sufficient for the prescribed quantities of liquid; since there still remains a considerable part which escapes its action. In all cases, the process is less embarrassing, and more secure from those accidents which are the consequence of a mixture too much charged, and which forms a mass; and is certainly less expensive.

Of the effects of mechanical division on resins which oppose the greatest resistance to solution.

We are acquainted with some resins, such as gum sandarac, copal, &c. which seem to resist more than others the action of the dissolving liquors. Copal, in particular, exhibits this character, when the artist endeavours to dissolve it in alcohol or essence of turpentine. This difficulty, however, may be overcome, with greater or less ease, by diminishing the doses of these substances. Simple mechanical division, carried as far as possible, and the mixture of a substance which readily suffers itself to be attacked, such as mastic and white incense, facilitate solution in a degree which could not be expected, if the two substances were treated separately, and in the usual manner. Experience alone can determine in regard to this point. We have already seen that camphor produces a great effect as an intermediate substance, but the doses must not be carried to excess.

Of the use of pounded glass.

When one is obliged to operate on a certain mass of matters, the form of the vessel employed is a matter of some importance. It is often different from what it ought to be. Its capacity is not always suited to the quantity it is destined to contain. In this case, the first impression of the caloric (heat) tends to agglomerate into one or more masses the whole resinous part destined to form the varnish, and by these means thwarts the intention of the artist, who employs his utmost care to favour and maintain that state of division which is so well calculated to promote speedy solution. When one is contented with simple stirring, which may oppose the union of the resinous parts, and even when broad-bottomed vessels are employed, this object cannot be accomplished. But the consequences of this inconvenience may be greatly diminished by employing a determinate quantity of pounded white glass which has been sifted through a hair sieve. It is mixed with the pulverized matter before it is united cold with the alcohol and the essence; and the division of the parts may still be assisted by stirring it with a rod of white wood, rounded at the extremity. By this simple mechanism the matter is kept in that state of divison necessary for the promptitude and perfection of the solution; and the tumefaction of the liquid, a circumstance much to be dreaded in the process of making varnishes, is prevented. Besides, the weight of the glass, which is greater than that of resins, makes it fall to the bottom of the vessel, where it presents an obstacle to the adhesion of the softened matters.

The use of a balneum mariæ is preferable to that of a sand bath in operations of this kind, because the temperature of the former has a certain fixed point of elevation, which it is impossible not to exceed with a sand bath; and in this case there will be great danger of communicating to the varnish a foreign colour, arising from the alteration which the resins experience from too great heat. After the operation, more or less of the resinous substance remains mixed with the glass. This residuum is reserved for the composition of common varnishes, which may be treated over an open fire.

Of clarification.

When the water of the balneum mariæ has been kept in a state of ebullition for a full hour and a half, if the matter of the composition amounts to no more than forty-eight or fifty ounces, there is reason to believe that the solution of the resins is complete. The circular motion with the stick must, however, be still maintained for half an hour after the vessel has been removed from the balneum mariæ. The whole is then left at rest, to give the undissolved matter time to be precipitated. Next day the clear liquor is decanted, and then put into proper vessels. Some artists strain the varnish, still warm, through a piece of linen cloth, and then leave it at rest for a few days to clarify.

In both cases, when it is supposed that the excipient is completely saturated with resin, it must be left for some days at rest. The effect of a high temperature is to dispose the vehicle to become charged with a greater quantity of the substances than it can retain when cold. This portion in excess is then precipitated, either in whole or in part, according to the season. When the precipitation is pretty extensive, small lumps of resin are formed around the vessel. This abandoned resin often affects a very distinct order of crystallization. Sometimes the precipitation is not so sensible: the varnish remains a long time turbid, in consequence of the separation of a portion of resin, which continues in a state of suspension. When this happens to be the case, there are two methods of giving to varnish all that limpidity which it is deprived of by the portion of suspended resin: add to it a warm excipient; this addition dilutes the varnish a little: or it may be filtered through cotton.

Of filtration through cotton.

This operation is simple. Arrange several funnels in as many appropriate receivers (*see Plate V. fig.* 4.), and place in the pipe of each funnel a small ball of carded cotton, about an inch in thickness; press this ball towards the point of the cone, to squeeze the cotton together, and place over it a small plate of lead pierced with several holes. Fill the funnels with varnish, and lay over the vessel a glass cover, or a few sheets of paper. The varnish which passes through the cotton is at first not very limpid; but when the cotton has imbibed a sufficient quantity the liquor passes very clear. The first portion of filtered varnish is then poured again into the funnels; and the filtration being continued, the result will be a very bright varnish, which is put into clean bottles. This filtration, which is soon performed, is indispensably necessary for every kind of varnish destined to be applied to delicate articles, such as cut-paper works, valuable furniture, paintings, philosophical instruments, &c. Care must be taken to keep the funnels full, and particularly not to leave the cotton uncovered; else it would become incrusted with a stratum of dry varnish, which might impede any further filtration.

When the whole is filtered, it will be proper to wash all the vessels with alcohol or warm essence of turpentine, according to the nature of the excipient. The product of the washing is kept in reserve till a new quantity of varnish is made.

On the preparation of varnishes in open vessels, and the precautions they require.

The varnishes, of which we have here given the different formulæ, are reserved only for articles of a certain value, and require particular care in the preparation. Those who prepare varnishes make other compositions which they destine, in general, for wainscoting, ceilings, common furniture, &c. Some prepare them in open vessels, and in the open air, in consequence of the accidents which sometimes take place when alembics are employed. It is indeed much easier to save from inflammation a matter which is seen to rise, than one inclosed in metallic vessels, where its tumefaction is not observed.

This labour on the first view appears to be easy. It however requires practice and perseverance to obtain the required result without any accident, and to quiet the well-grounded fears which those in the neighbourhood may conceive of the danger likely to arise from this process. It will be proper to perform this operation in the day-time, and in the middle of a spacious court or garden. The vessel ought to be furnished with high edges, that the torrent of vapours which escapes may not communicate with the undulating flame which often extends beyond the fire-place. Care also must be taken to dispose the vessel in the furnace in such a manner as to cover the fire entirely, and to prevent any portions of the varnish which may be thrown up by a false movement of the spatula from falling into it.

The precautions to be observed, however, are not confined to the manipulations usual on such occasions. When the solution is completed, it is customary to deposit the varnish in an apartment or workshop to cool, and also to give it time to clarify. This apartment then becomes filled with vaporific emanations, to which fire may be communicated by an inflamed body. These vapours are the more dangerous as they extend themselves to a great distance, even beyond the apartment, so that the contact of a lighted taper may occasion an explosion which will carry the flame to the reservoir of the evaporating substance. I have witnessed, along with a great number of auditors, a similar effect, which is often accompanied with very alarming circumstances. Great care then must be taken not to enter with a candle into an apartment which may contain such an inexhaustible source of vapours, so highly inflammable.

If the method of making varnish in open vessels seems to hold forth some advantages, it is not free from inconveniences. The artist, indeed, may carry on his operation in more security. He can easily prevent the tumefaction of the matter, and consequently those accidents which result from it. By means of continued motion he may easily afford means of escape to the vapours in a state of expansion; and may renew the surfaces of the resin which touch the bottom of the vessel, and which, by being altered, might colour the varnish. This is the favourable side of the method; but I shall exhibit also the reverse.

This process occasions a very great loss of alcohol or of essence, in consequence of the vapours which rise from the mass. These vapours are furnished only by the more subtile part, or that fittest for the solution of resins, and which contributes most to the excellence of the varnish, to its pliableness and lustre. The physical effect which the constant vapour of the essence may produce on the nerves of the artist exposed to it, if he is of a weak constitution, is not a matter of indifference; since it sometimes occasions a state of asphyxia. However great may be the precautions taken in processes of this kind, if they have not always been sufficient to prevent serious accidents, this is sufficient to justify the fears of individuals who reside in the neighbourhood of the varnisher, and to excite the vigilance of the police to confine to the outskirts of cities all establishments of this kind. Geneva never reflects without terror on the fires which have taken place on different occasions, and on the misfortunes which have thence resulted to individuals. I consider it therefore as my duty, since I am treating on varnishes, to endeavour to find in the form of the vessels and apparatus means proper for obliterating the painful remembrance of these public calamities, or at least of rendering them less frequent.

Description of an alembic proper for the preparation of varnish.

The common form of an alembic will not admit us to hope that the solution of resins can be rendered complete, and that those accidents which arise from agglomeration of the resins, and particularly from an accumulation of the vapour which in that agglomeration finds a resistance which it endeavours to overcome, can at the same time be prevented. The matters then become tumefied, raise up the capital, spread with an explosion to the fire, often even to the artist, and in this manner occasion conflagrations. The smallest accident which results from the use of a common alembic is the coloration of the varnish, in consequence of an alteration which the resins experience, by adhering to the bottom of the vessel. These effects would not take place if the form and construction of the alembic afforded the artist the means of maintaining a circular motion, which would change the points of contact of the inclosed matters; and if, instead of fire being applied to these matters in an immediate manner, it were applied mediately, as is the case when a balneum mariæ is employed. These two conditions appear to me to be answered by the construction of the apparatus here described (*see Plate V. fig.* 1.).

It is an alembic and a balneum mariæ with a refrigerator. It consists, 1st, of a common alembic; 2d, a balneum mariæ; 3d, a capital; 4th, another separate piece which performs the office of a refrigerator, and which is adapted to the alembic at the moment of the operation.

The alembic *a*, fig. 1, is of copper, and made in the usual form; the aperture *b* terminates in a tube, destined to receive the pipe of a funnel, for the purpose of affording an escape to the incoercible vapours which arise from the water in a state of ebullition. This piece then serves as a receptacle for the water of the balneum mariæ.

To this alembic is adapted the balneum mariæ *c*, made either of tin or of copper; it has the same form as that of the common alembics, and serves to contain the substances which are to compose the varnish. The bottom of it is horizontal, perfectly flat, and about an inch less in diameter than the mouth. The upper part of this piece is strengthened by a circular band, which serves to cover the joining where the capital is fitted to the alembic. To save expense, this circular band may be made of lead.

The diameter of the capital *d*, at the base, is proportioned to that of the balneum mariæ, in such a manner as to join with the circular band. This piece terminates in a dome, which at the summit has a pipe or aperture *e*, half an inch in diameter. A metallic bar *f*, fig. 2, soldered at the two extremities, and pierced with a hole corresponding in a vertical direction with the aperture *e*, and having the same diameter, passes through the middle of the lower end of the capital. These two apertures are destined to maintain, in an exact vertical position, a small rod of iron *g*, connected on the outside with the handle *h*, which is of wood, and moveable. The lower part of this rod, which is continued to the bottom of the balneum mariæ, is furnished with an iron cross *i*, cut into teeth, while its two extremities are raised up, as seen at *k*: the lower part represents an inverted ⊥. *See fig. 2 and 3.*

In the upper part of the capital *d*, is formed a second aperture *l*, which terminates also in a tube, capable of containing a cork stopper. This aperture facilitates the re-introduction of the parts of the liquid obtained by distillation.

A conducting tube *m*, the diameter of which is twice as large as that of the beak of common alembics, taking into account their capacity, proceeds from one of the sides of the alembic. It is by this canal, which is made of a sufficient length, and which is of an equal diameter throughout, that the refrigerator *n* is connected with the alembic.

The refrigerator *n* is constructed in such a manner as to afford a free passage to those matters which might become tumefied, or to condense the vapours which escape from the interior part of the vessel. Both these ends may be accomplished by means of a plain wooden box, well joined together, of an oblong figure, through which a tube *o*, made of copper, tin, or tin-plate, passes in an oblique direction. This tube, throughout its whole length, is of the same diameter as that which proceeds from the capital, and is only a continuation of it. When used, the box or trough is filled with cold water.

The extremity of this tube terminates in a bent part, *p*, of the same diameter as the rest, Under this part is placed the vessel *q*, destined to receive the product of the condensed vapours, and, in case of need, the matters which may be raised in the interior part of the apparatus, by the effect of caloric (the heat), or in consequence of the consistence which the liquid acquires in this kind of operation, or by the negligence of the artist to stir it during the process.

This alembic is placed on a portable furnace of burnt clay *r*, or on a fixed furnace constructed of bricks or other materials: it ought not to be too high, lest the artist should be incommoded in managing the handle *h*. It has the same form as other furnaces, and is only modified in the manner of placing the chimneys or vent holes, which ought to be disposed in such a manner as to be sheltered from the contact of the inflammable matters, that may fall on the edge of the furnace. This end may be obtained by making the apertures of these chimneys issue through the sides of the furnace, at the distance of two or three inches from the upper edge, and forming over each of them a small projection. The same purpose will be answered by placing on a common furnace a ring, the edge of which, *s*, extends about an inch beyond the exterior diameter of the furnace. This ring supports the alembic. It may be made of burnt clay, or a kind of soft stone which is very common in the neighbourhood of Geneva.

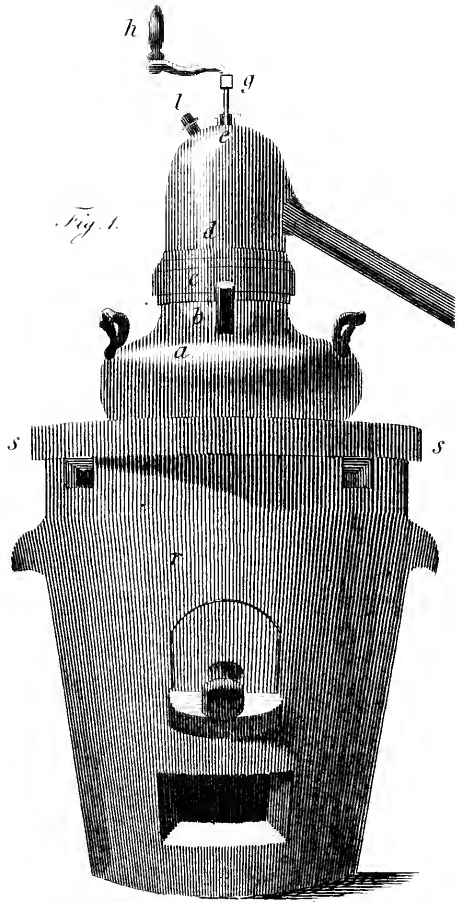
Remarks.

Distillation is a process so common that any one may conduct it. I might, therefore, pass it over in silence; but when applied to the present object it requires, on the part of the artist, more attention and more care than in ordinary cases. Nothing must be neglected, if one is desirous of avoiding all reproach in case any disagreeable event should take place. The following then is the conduct I should observe in the preparation of varnish, according to the method here proposed:—

When the matters are put into the balneum mariæ, cover that part with its capital, and cause the agitator to touch the bottom of it. Lute the two parts exactly, at the place where they are united, with bands of paper and flour paste. Then make a few turns with the handle before heat is applied, to divide the matter; keep the tube *b* of the alembic open; and shut closely the tube *l*. Adapt the refrigerator to the alembic, and cement a few slips of paper over the place where the two vessels are joined; introduce into the alembic such a quantity of water that the body of the balneum mariæ may be half immersed in it, and then kindle the fire.

It is of some importance to move the agitator, at the moment when the fire is kindled. If this precaution be neglected, the resinous matter forms itself into a mass, and in that state opposes more resistance to the action of the vehicle. Continue the rotary motion during the whole process, but without too much precipitation. The solution to be complete requires only an hour or an hour and a half, reckoning from the moment when the water begins to boil.

If the level of the water employed be fixed at half the interior height of the balneum mariæ, or a little



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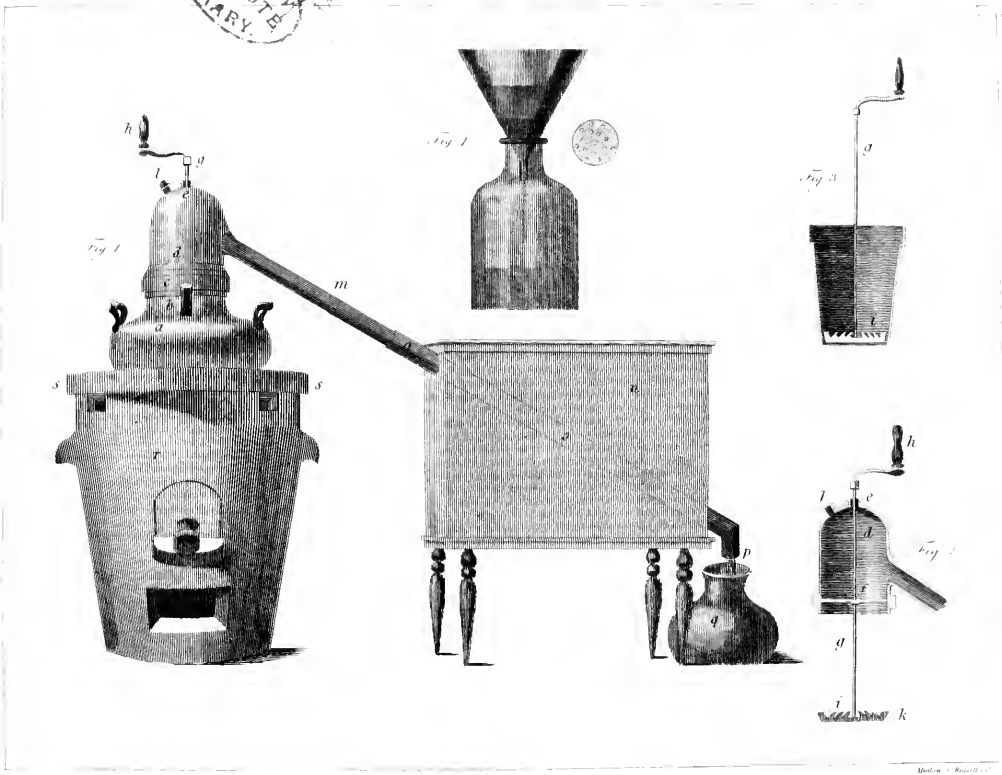

Allembic for the preparation of Varnish.

higher, the inconveniences attending too great a quantity of that liquid will be avoided. By the force of ebullition part of it is thrown up through the tube, and often incommodes the artist; but there is still a greater inconvenience. When the balneum mariæ is thus completely surrounded with a boiling liquid, the vapour of which has not the means of free escape, the alcohol, which becomes so much more charged with caloric as it acquires greater density, in the ratio of its union with the resinous part, tumefies, and escapes as it boils up through the apertures which it meets with; and if it should unfortunately experience the least obstacle to its forced emission, it would burst the vessel, and inundate the artist with matters, which being soon inflamed by their vapours coming into contact with those that fall into the fire, would expose him to the danger of losing his life amidst the most excruciating pain, as has frequently been the case.

If the kind of alembic here described were destined for various other uses, like those in chemical laboratories, there might be reason to apprehend the effects of some negligence in regard to the care that ought to be taken to keep the tube *b* open, when the distillation is carried on with a balneum mariæ; and to close it with a stopper when distilling with an open fire, that is to say, without a balneum mariæ. For the present purpose there is never need of employing this alembic on an open fire: consequently the artist is not under the necessity of shutting the tube, and by these means he avoids those accidents already mentioned. In the contrary case, the vapours of the boiling water being accumulated, and finding no way of escape, would soon burst the apparatus, or would exercise a still greater action on the matters in the bath than if the alembic were filled with boiling water.

In proportion as the caloric (heat) acts on the substances inclosed in the balneum mariæ, it unites itself to portions of the vehicle, which it reduces to vapours. A part of these vapours are condensed in the inside of the capital, and fall back on the matter. Another part, escaping from the interior of the apparatus, is condensed in the lateral tube, which traverses the refrigerator, and proceeds in a liquid form into the receiver. This product is composed of the most volatile and the most subtile part of the liquid employed for the solution. This loss, if extended, diminishes in a considerable degree the energy of the alcohol not volatilized: in a word, the quality of the varnish would suffer by it, if the product of the distillation, when a certain quantity is collected, were not restored to the mass. The aperture *l* is then opened, and a funnel of tin plate is adapted to it, through which the liquor that has escaped in the form of vapours is restored to the varnish. The cork stopper is again put in its place; and the circular motion of the agitator is continued. I think it needless to recommend the utmost care that no portion of the liquid introduced may be suffered to fall into the furnace: artists must be well aware of the consequences.

Several compositions require the use of turpentine;

but it must not be put into the bath at the same time as the resins; because, being more disposed by its liquid nature than dry resins to combine with the alcohol, it would occupy the whole of the latter, which would not exercise on the other substances the energy requisite. The mixture of it, therefore, must be deferred till towards the end. It may be easily added, by melting it over a slow fire, and introducing it in the same manner as the product of the distillation. A portion of the distilled alcohol is reserved for washing the vessel which contained the turpentine, and the funnel which has been employed.

When it is judged that the solution of the resinous matters is finished, the whole of the fire is removed from the furnace, and the circular motion of the agitator is continued for half an hour, leaving some intervals of rest. When the apparatus has in some measure cooled, a sponge dipped in water is drawn over the pieces of paper which cover the joints; and they are then removed as well as the capital, which has been separated from the refrigerator. The varnish being then decanted into proper vessels, it may be strained through a piece of dry linen, or filtered through cotton.

This operation ought to be performed in the day time, lest the inflammable vapours which may escape should be set on fire by the candles. The artist, who undertakes this labour with the precautions I have pointed out, will always be secure from those accidents which, in this process, are attended with so dreadful effects.

It ought always to be remembered that alcoholic varnishes never should be prepared in larger quantities than may be required for immediate use; because they do not long retain those qualities which render them valuable. When too long kept, they become yellow and greasy. In this respect they are very different from oil varnishes, which improve by time.

CHAPTER V.

Observations on the influence which the solar light has to render essence of turpentine proper for the solution of copal, so as to compose a durable and colourless varnish.*

Every art which consists only in the employment of a certain number of bodies has, no doubt, fixed boundaries, and becomes more susceptible of modifications in its processes than of important discoveries. This may be applied in the utmost strictness to the art of the varnisher. It consists only in the solution of certain resinous substances in spirituous and oily liquors, which however require some particular preparations.

It was not till within these few years that this art was reduced to certain principles capable of serving the artist as a sure guide in conducting his operations. In this respect it has undergone a sort of revolution, for which it is indebted only to that part of practical chemistry which has been brought to a level with the comprehension of artists. The necessity of gratifying the general taste in every thing that regarded the decoration and elegance of apartments, furniture, &c. was the first cause which tended to produce it; and simple compositions were substituted in the room of those recipes with which works that treated on the secrets of the arts abounded. Each solution has its particular

* This forms the substance of a paper presented in 1788 to the society formed at Geneva for the encouragement of the arts, agriculture, and commerce.

laws, depending on the nature of the bodies, and of the liquors which seem to be suited to them. By reducing this art, therefore, to a regular method, the extension of it has been rendered more certain, or at least more probable; and each discovery, supposing that any can be made, will find a place marked out for it in the series of formulæ, the distinguishing characters of which lead to a methodical division, rendered necessary by the present state of our knowledge. It was under this point of view that Watin published, in 1772, his Art of making and applying Varnishes.

Of the matters employed for the composition of varnishes, copal and amber are reserved for those which require fat oils as their vehicle. At any rate, these two substances have hitherto been considered as insoluble in alcohol and in essence of turpentine. The hardness, purity, and transparence of copal have rendered this kind of resin an object of many researches. Various methods have been tried to dissolve it, but without apparent success. The use of turpentine in the room of alcohol gave only uncertain results. Some chemists assert that they have made varnish in this manner; others say it is impossible. Artists who practise the art of varnishing declare in favour of the latter opinion.

This state of uncertainty, instead of making me abstain from researches on this subject, has, on the contrary, rendered it more interesting to me, and more worthy of examination. The advantage which might result from the discovery of some process capable of communicating to varnish the intrinsic qualities of this dry matter, held forth a stimulus which it was difficult to resist. I therefore undertook a series of experiments on it, which form the subject of this chapter. An artist, no doubt, would not have carried it to the same extent; but it was necessary for me to exhibit it under another point of view than a mere formula, since the detail of the results necessarily leads to physical researches absolutely foreign to the art of the varnisher.

I announced in the article which treats of copal: 1st, that this substance is partly soluble in alcohol; 2d, that it may be entirely dissolved in it by means of an intermediate substance; 3d, that ether generally effects a solution of it, and in pretty large doses, according to the state of the ether, and the particular nature of the copal; 4th, that essence has the same property, but with certain limitations, which seem to depend on a particular state of density.

The solution of copal in alcohol was not sufficiently complete to afford any hopes of a satisfactory result. That which takes place by means of an intermediate substance was attended with an inconvenience, which there was reason to think might be obviated in the solution that seemed possible by essence. The latter vehicle exhibited in its physical properties characters nearly similar to those of alcohol. Like that fluid it is exceedingly limpid, liquid, and colourless. It possesses a mean density between that of alcohol and the density of essential oils: in this even it seemed to have with copal an analogy more striking, and which might lead to effects of solution that could not be expected from alcohol. I confided, therefore, with the more reason in the strength of this analogy, as the particular nature of the essence permitted me to increase or to lessen at pleasure its common density.

It was on these bases that I founded my researches. The first did not afford me cómplete satisfaction. I renewed my experiments; but the results still seemed to be very imperfect. I sometimes found that the esssence which had exercised a partial action on the copal produced no effect at a more elevated temperature. In other circumstances, the same liquid which refused to unite with copal laid hold of it with eagerness after an interval of some weeks. At other times, mixtures of copal and essence kept in a state of infusion for twenty-four hours without exhibiting any apparent solution, required only a maceration of some months to display all the characters of a complete solution of this kind, and at length of a beautiful varnish. I observed also, that of a certain number of matrasses which contained mixtures of copal and of essence, in doses perfectly equal, and which experienced no other difference but that arising from their position in different parts of the laboratory, several, some months after, exhibited all the signs of a complete solution, while others showed no indications of it. I saw some also in which the copal remained under the form of lumps, covered with an amber-coloured liquor.

I evidently foresaw, that to clear up so many doubts, and to discover the truth amidst so much contradiction, a great many experiments would still be necessary. I had, however, reason to think that the solution of the copal depended on a certain state of the constituent principles of the essence. I was then sensible of the necessity of mixing it with copal possessed of different degrees of tenuity or density, which might be communicated to it by art; and I expected I should be able to find that point best suited to the solution of this kind of resin, without communicating colour to the varnish.

The following experiments were undertaken in consequence of this new plan of research; but I must observe that I always made use of the same copal, in the state of powder, and of the same essence of turpentine.

1st. Liquors susceptible of volatilization at a certain temperature always exhibit in their ascent products the more attenuated, as they have required less caloric (heat), and consequently less time to be volatilized. Such is the case with alcohol, the first product of which is more subtle than the succeeding.

Certain light essential oils are subject to the same law. By applying to the rectification of essential oil of turpentine the method employed for the rectification of spirituous liquors, dividing the products into several portions, I had reason to believe, that those which passed over the last would be less fluid, as well as less ethereous, than the first; and that the difference observed in their respective densities would follow a gradual progress, according to the different periods of the distillation. As it was necessary that this labour should be rendered so easy as to be within the reach of artists, I was obliged to adopt a less complex process.

I therefore divided into six equal portions, by means of a tubulated balloon, the product of seventy-two ounces of essence of turpentine, distilled in a balneum mariæ, according to the method described in Chap. II. Each of these portions was put into a numbered flask, and the sixth flask was destined to receive the residuum of the distillation.

It was necessary that I should first examine the specific gravity of each of these six portions, and compare them in regard to their power over the copal; but I was prevented by a tedious illness, and other occupations of a more urgent nature, which left me no time for chemical researches. I, however, took the precaution to close the flasks exactly, and to shelter them from the light by shutting them up in a closet, where they remained nine months.

2d. At the end of that period I found four of the flasks covered in the inside with beautiful crystallizations, consisting of prisms grouped together in a divergent form.

No. 1. exhibited small needles, which crossed each other in every direction. They were transparent, and had a silky appearance. A great part of these crystals covered the bottom of the vessel; some also adhered to the sides, below and above the level of the essence. The most apparent of these crystals were 5½ lines in length.

No. 2. presented two pretty large groups of prismatic crystals, diverging from a common centre. The largest were six lines, or half an inch, in length.

No. 3. showed only some rudiments of crystals, scattered over the sides of the glass above the level of the essence.

No. 4., besides small crystals adhering for the most part to the sides of the glass, above the liquor, contained three beautiful groups, in part divergent, and crossing each other different ways: most of these prisms were half an inch in length.

No. 5. presented no crystals but at the bottom of the vessel. They were, however, so numerous that they covered the raised part of the bottom. Many of these prisms were insulated; others were disposed in divergent radii, in such a manner that one prism served as a base to four or five others, which adhered to it only in one very acute point. The largest did not exceed three lines.

No. 6., which contained only the residuum of the distillation, and which had a strong amber colour, exhibited no appearance of crystallization.

If these crystals really varied in regard to their dimensions, the case was not the same in regard to their form. In all of them I observed the quadrangular, flatted prism, with two large and two small faces. They were prismatic laminæ truncated horizontally. In some crystals the extremities were continued to a point.

3d. These crystals, when taken from the essence, and exposed on brown paper to dry, have very little solidity. They dissolve in alcohol and in water, the limpidity of which they destroy. There is separated from them a little oil, which floats on the surface. This effect arises, no doubt, in a great measure from the portion of essence with which they are still enveloped.

The solution of this salt exercises an action on blue vegetable colours, and makes them become red. It did not appear to me to exert much energy on a solution of carbonate of potash. The vehicle in which the salt was dissolved weakened its strength.

This solution, when presented to caustic potash, becomes saponaceous, and small threads are formed in it.

This concrete, volatile salt almost always appears in an oil exposed to the influence of the light, though no crystals are produced by cooling, or by its remaining in a cold place. In this case, it is more disposed to fix itself above the level of the oil than below it. The process which accelerates its formation consists in making the essence pass over the upper and uncovered parts of the vessel. Evaporation has a considerable share in the production of the phænomenon. But, if a matrass half filled with essence, and which already exhibits crystals in the part not occupied by the oil, as well as in the bottom, be exposed to the ardent sun, the former will almost always remain, and often even increase, while those covered by the liquid dissolve into a kind of reddish water, which falls to the bottom of the vessel. This water is exceedingly acid. It effervesces with alkalies, renders blue vegetable colours suddenly red, and impresses on the tongue a caustic and burning savour. The salt which produces it appears to be of a benzoic nature: a kind of crystallized acid soap.

The concrete, volatile, acid salt of the essence of turpentine, covered by the fluid which produced it, is susceptible then, in this particular case, of dissolving in water, in consequence of the same cause which makes it appear on the free sides of the vessel. A temperature somewhat higher than that of the atmosphere would be sufficient to separate the acid from the oil, which serves as a basis to the crystals. I do not know whether these effects would be constant. I am, however, inclined to believe they would; as I consider them to depend on the reaction which the light favours between the acid principle and the oily body. They are those I observed on the six bottles I had exposed to the sun; and I have since observed them in a great number of similar cases. This phænomenon of liquefaction, however, was observed in crystals which had been formed in the course of twenty-four hours above the level of the oil, and under the oil; and which I had kept some time in the cellar, in vessels closely shut: but the crystals which were dry experienced the same fate as those immersed*.

* The Pharmacopœia of Charas, p. 107 and 108, speaks of a volatile salt of turpentine; but, according to the old language of chemistry, it exhibits only as it were a substance concealed in oil, essential to its nature, and to which the author ascribes all the effects of essential oil on the bladder. "The volatile salt," says he, "which is concealed in the acid part of the ethereous spirit, and in the oils first distilled, contributes greatly to the virtues ascribed to them, the principal of which are, that they open the urinary conduits, moderate the heat of them, prevent the formation of calculi, &c. &c."

In this passage we see nothing that indicates the existence of an essential salt developed and crystallizable.

Poultier de la Salle enlarges a good deal on the distillation of ethereous oil of turpentine and balsam of turpentine, in the learned observations with which he has enriched the Translation of the *Pharmacopœia Londinensis*. He admits there an acid phlegm, as

I did not extend any further my researches on the nature of this salt, the acid of which appears to me to approach very near to the nature of the benzoic acid; but, in the mean time, it may be defined an oily, acid salt, analogous to that extracted from balsams. The volatile salt of amber, perhaps, might be traced back to a similar origin; and if its chemical properties seem to be different, this may be ascribed to the influence of the mineral vapours, which for so many ages have been exercising an action on the resinous matter which constitutes amber. These vapours must necessarily have changed its principles, or brought them gradually to that point of modification which removes amber so far from the nature of our common resins, and even from that of copal, which seems to approach it most, as I have since shown.

I was perfectly sensible that it would be of great importance to carry to a greater extent these researches on an object so nearly connected with the natural history of fossil resins. I might have attempted a greater number of experiments to discover the peculiar nature

in the distillation of resins and balsams; but he makes no mention of a volatile, acid essential salt. If this concrete salt had been observed, that valuable repository of the Stahlean chemistry would have noticed its existence.

When essence is distilled with a sand bath, if the retort be covered with a dome of baked clay to facilitate the expulsion of the vapours which circulate above the boiling liquid, this apparatus contributes to the speedy appearance of this concrete salt, because there is less reaction from the fire on the principles of the oil. Twenty-four hours after the distillation of two pounds of essence I was able to extract 27 grains of this concrete salt.

of that salt, and to trace it in its different combinations with different bases; but as this part is absolutely foreign to the arts, I thought proper to confine myself to a plain account of the phænomena exhibited in the course of some experiments, the only object of which was the solution of copal in essence of turpentine.

4th. It appeared necessary to examine what might be the specific gravity of each of the numbered divisions of the oil, before I applied them to the copal. I had only Homberg's hydrometer and common balances at that time in my possession; and I confess that these instruments would not bear a strict comparison with others since constructed for me by one of our artists, well known to philosophers by his talents and ingenuity. They were, however, sufficient to convince me that the degree of the tenuity of my specimens did not follow a progression corresponding to the period of their appearance in the course of the distillation. No. 4. had a specific gravity less than No. 1., and the latter was some grains heavier than the common essential oil of the shops, which had been employed for the distillation. The one last mentioned was to distilled water nearly as seven to eight. I shall enter hereafter into more circumstantial details respecting the specific gravity of similar productions.

5th. This variety in the specific gravity of these different specimens of the same oil would not have stopped me, had these specimens been fit for that kind of solution which was the principal object of my researches; but none of them could take up such a quantity of copal as was sufficient to make a varnish. The reader may judge of their degree of energy by the account of the following comparative experiments which were all made in small new matrasses.

Ten grains of pulverized copal were mixed with an ounce of each of these separate oils. Each matrass, immersed in warm water, was kept for half an hour in a state of circular motion; but under the present circumstances, this process, which in other cases was sufficient to dissolve 72 grains of copal in little more than an ounce of essence, was not capable of carrying the solution, in each of these oils, to more than ten grains. No. 1. approached nearest to the limpid state, which announces a commencement of solution; the precipitate in it was less abundant. The other small matrasses, distinguished by a number corresponding to that of the flask from which the oil had been taken, showed the copal collected at the bottom in the form of a white glutinous mass, tough and tenacious. This toughness and tenacity, which are not commonly observed in the parts of copal treated with a lighter and more ethereous essence, indicated however that these oils were disposed to operate the required solution.

Under this supposition, and in consequence of observations made in former trials, I closed exactly the matrasses, as well as the bottles containing the specimens, and left them for a year on one of the shelves in my laboratory. Their situation was such, in regard to the solar light, that they received it only by reflection during four or five months of the year. I waited a long time, and my expectations were not deceived.

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6th. At the end of the year I examined the small matrasses, and the oils corresponding to them. The results exhibited by the former were as follow:

No. 1. was limpid, and showed neither residuum nor colour. A drop of water occupied the bottom. I mixed with it ten grains of copal, after having exposed the matrass to a temperature of from 122° to 144° of Fahrenheit. The copal disappeared in a few moments: forty grains introduced at intervals, in doses of ten grains, disappeared in like manner. The varnish thence resulting had a beautiful consistence, and showed, by its nebulous tint, that the point of saturation had been observed. Motion alone, without the aid of heat, was sufficient to complete the solution in a quarter of an hour. Here then, by adding more copal to the first ten grains, I had fifty grains of that matter held in perfect solution in an ounce of essence.

No. 2. was of a slight amber colour; the copal had disappeared, and there were separated from it two drops of acid, which, by reacting on the principles of the oil, might serve to explain the origin of the tint assumed by the essence. This specimen had also become charged with forty grains of pulverized copal, introduced at four different times.

No. 3. exhibited a tint somewhat more apparent than the preceding. Two drops of acid water had separated from it; but the liquid was nevertheless transparent. It had become charged with the same quantity of copal as the preceding.

No. 4. had still more of an ambery colour than Nos. 2. and 3. It contained also acid water. The same quantities of copal were attended with the same success as in the former cases.

No. 5. was nebulous; which I ascribed to some motion accidentally given to the matrass: the water was then confounded with the oil. It had the same tint as the preceding, and presented the same extent of solution as the former specimens.

No. 6. had a reddish colour, and I extracted from it some drops of very acid water. It appeared to be the least proper for making varnish, as it had been capable of admitting only thirty-five grains of new copal, instead of forty.

All these specimens of varnish had the required consistence. They were exceedingly oily; extended themselves freely when applied under the influence of the sun; and, in summer, required only two days to form on ivory or on wood a solid and brilliant glazing.

It may be seen, in this account of my researches, that these oils, which were incapable of becoming charged with copal during the first trial, experienced in the course of time a particular modification, but necessary to establish a kind of analogy which ought to exist between the principles of the two substances in contact. Was the efficient cause of this modification the contact of the essence with a certain quantity of copal? It may be recollected that each of the small matrasses, subjected to experiment, contained ten grains of pulverized copal. This question, therefore, may be answered by an examination of the oils contained in the corresponding flasks.

7th. At this period I had received my instruments and balances, the correctness of which enabled me to ascertain the smallest differences. The specific gravity of the oil in each of the six numbered vessels was examined by a flask capable of containing an ounce of distilled water, Fahrenheit's thermometer being at 59°. The following table exhibits the results, in the order of their numbers:

Table exhibiting the specific gravity of the numbered oils.

Order of the numbers.	Specific gravity compared with that of an ounce of distilled water.		Relative decrease in the absolute weight of the ounce of distilled water.
	Gros	Grains.	Grains.
No. 1. .	7 .	60	12
No. 2. .	7 .	37	35
No. 3. .	7 .	58	14
No. 4. .	6 .	70½	73½
No. 5. .	7 .	57	15

In establishing the scale of these numbers, according to their greater lightness, I shall place them in this manner: No. 4, 2, 5, 3, 1. No. 6. was not comprehended in this examination, because, being only the residuum of the distillation, it was too thick and too highly coloured to enter into the composition of varnish.

8th. When the specific gravity of these oils was known, it remained to ascertain, whether the solution of the copal in the essence, contained in each of the small matrasses, which was very much extended, ought to be ascribed to a modification effected in the essence itself by the contact of the copal, which had incorporated with it only flowly; and whether this copal, when once united to the essence, would not communicate to the latter the property of seizing upon new portions of the resin. It was necessary, therefore, to apply to an ounce of oil taken from each of the numbered specimens, the same quantity of pulverized copal, that is to say, fifty grains, using only ten grains at a time, as before. The following were the results:

The essence No. 1. could dissolve only forty-eight grains of copal, and the solution was turbid. No sediment was produced by two hours rest; and the addition of $\frac{1}{8}$ ounce of the same essence formed a varnish of a good consistence, and very clear. Some clouds only were observed at the bottom of the vessel.

No. 2. was treated in the same manner for the solution of the first forty grains of copal; but the last quantity introduced remained untouched. The varnish, which floated over this sediment, was turbid; and half an ounce of essence was required to make a varnish of it similar to the preceding.

No. 3. was like No. 1.; but, after twelve hours repose, there was separated from it a small portion, which might be estimated at two grains: the addition of a quarter of an ounce of the same essence, however, made it disappear.

No. 4. refused to unite with copal: the whole matter was precipitated, a few grains excepted. The oil had experienced no change in its colour or consistence. The copal formed a mass in it.

No. 5. gave, with fifty grains of copal, the same result almost as No. 2.; but no precipitate was formed at the time. The state of the solution, however, announced that it would soon appear. It was less voluminous than in No. 2.; and only three-eighths of an ounce of new essence was necessary to make it disappear.

If the specific gravity observed in the numbered oils be compared with their different degrees of power over the copal, we shall find that this power acts in the inverse ratio of their tenuity and lightness. The more distant, then, that essence is from the state of ethereous oil, the more energy it exerts on copal. This simple theory is sufficiently proved, first by the inactivity of the essence of the shops, which I tried before I subjected it to distillation (1); and then by that of the oil numbered 4., which we have examined (8).

9th. To these examples might be added others taken from different experiments, the details of which are suppressed, to avoid extending this chapter to too great a length. The following result, however, deserves to be known: an oil which had no action on copal two months after rectification, took up forty grains per ounce eleven months after; and fifty-two grains at the end of eighteen months. The varnish was not more coloured than alcoholic varnish prepared with the greatest care*.

Was this owing to the effects of the light? or was it owing only to time, which, without any intermediate

* The specific gravity of this oil, examined by the test containing an ounce of distilled water, the thermometer being at 52°, was:

At the first period	6 gros	64 grains
At the second - -	7 gros	68 grains
At the third - - -	1 ounce	7 grains.

substance, disposes the parts of the oil to assume peculiar characters, which add to their specific gravity, and which render them more proper to become charged with that resin?

This is a question of so much importance that it deserves to be carefully examined*. But, before I enter on this subject, I shall present the reader with a few considerations on the mutability observed in the properties of essence of turpentine.

10th. What takes place in a varnish in which a sediment of copal is formed may be considered as a new fact, the real cause of which can at present be only conjectured. Whatever care may be taken to favour the solution of the part precipitated, either by the addition of an oil, or by the use of caloric and motion, it remains entire, or the part made to enter into solution is so small as scarcely to be worth notice.

The same phænomenon is exhibited by varnishes which are only turbid. It would appear that copal contains two substances, the principles of which, differently modified, are however susceptible of an intimate combination, as seen in some bodies distinguished by the name of *resinous gums* or *gummy resins*. A

* Some particular facts had familiarized me in some measure with the idea that the light had had some influence on the present results. It was therefore necessary to ascertain it in a direct manner. I consequently made researches on the subject, and I gave a detailed account of the results in a memoir inserted in the *Journal de Physique* for March 1798. These results confirm that light alone was the cause of the phænomenon, and it is greater and speedier when the oxygen gas of the atmosphere has free access to it.

liquor, then, the principles of the composition of which have a more striking analogy to one of the two component parts than to the other, will be able to separate them. By this separation the insoluble part would become only more refractory to the action of the vehicle, and the quantity of it would even be increased, because it would be deprived of its means of union. Several substances exhibit these phænomena when brought into chemical contact.

Notwithstanding the instances which might be adduced to justify this opinion, or to give it every character of probability, it is here offered merely as a conjecture. It may not, however, be improper to call the reader's attention to what takes place in a mixture of copal or of amber with alcohol, and with ethereous essence of turpentine. These liquors seize on a slight portion of these two kinds of resin; but their energy is confined in such a manner, that if the vehicle of the first infusions be decanted, and its place supplied by a new quantity of liquor, the latter will exercise a still weaker action than the former, and so on in succession; because the part of these resins which is soluble by this kind of process has been extracted, or because what remains is so enveloped by the insoluble part that it is secure from every attack.

This may have some relation in theory with our sediments of copal, the solution of which cannot be completed till the vehicle in contact has undergone, in its principles, new modifications, which develop in it new affinities with the resinous substance. It is thus that we may judge of it from what has been observed in sections 5, 6, and 8. The same chemical effect may take place also when colourless essence, but of a density which may be compared to that indicated in section 9, is employed.

11th. Another phænomenon, which deserves no less to be examined, is the ambery colour which the varnish assumes when made with essence easily decomposed, and which readily yields water. The varnish speedily assumes colour, if by means of a few shakes the small drops of water adhering to the dome are precipitated to the bottom of the matrass. This water, which is acid, reacts on the oily principle, and alters it.

Every essence of turpentine does not equally produce this effect; which seems to depend on its nature, and the strength of the acid it contains. Of seven matrasses containing this oil, of different degrees of density, and exposed on sand at a temperature of 200 degrees, there was only one which could serve to support the present observation. The experiments mentioned in the 6th section prove the truth of it. When similar oils are used, it will be proper to substitute a balneum mariæ for a sand bath, if a colourless varnish be required.

12th. The facts observed in mixtures of essence with a small quantity of copal (5) render it necessary to offer some observations on that subject. What, then, is the cause of this solution, which I have seen carried further on a small quantity of copal (6), with oils preserved in small matrasses, than with the same oils without mixture (8)? The former were able to dissolve fifty grains of copal per ounce; while the latter required the addition of a new quantity of essence to take up from forty-eight to fifty grains. It will be recollected also, that this addition of essence was made in the relative and inverse ratio of the density of the oil, which served as a basis to the experiment (8).

Two causes may concur to produce the effects observed in the matrasses charged with ten grains of copal. The first arises from the density of the essence. This density, acquired by the solution of a portion of the copal, extends to the oily body its quality of refracting the sun's rays. It disposes it to collect a greater quantity, to yield to their influence, and to acquire from them modifications capable of developing a certain analogy between the principles of its composition and those which constitute copal.

The second cause may arise from the precipitation of their acid, which has followed the solution of the first grains of copal. This separation of a part of the water contained in the essence itself does not take place in specimens of the same oil without mixture. It appears that the essence in the matrasses has undergone a kind of analysis. By this subtraction of a portion of the aqueous principle, essential or foreign to the composition of the oil, but so contrary to its resinous combinations, the essence must have assumed a more oily consistence, and have formed a whole of a greater density. This agrees very well with the anterior observations, which indicate (9) that the density of the essence, carried to a certain determinate point, becomes a character essential to the solution of copal.

These two conjectures seemed likely to open a new field for experiments, and the results of them might become as interesting to philosophy as the first object of this chapter appeared to be to that part of the arts to which it relates. The matrasses and bottles which contained the proof oils were closely shut with cork stoppers. The varnish, which had dried around the stoppers of the matrasses, so as to form a kind of mastic, left no doubt in regard to their perfect obturation. To explain the increase observed in the density of the oil, it was impossible to suppose a loss occasioned by the evaporation of the most ethereous part of the essence, since there was no apparent decrease in its volume, the level of which had been marked by small bands of paper pasted on the outside. The same cause which opposed the volatilization of the oil appeared to me still sufficient to present an obstacle to the introduction of the oxygen gas of the atmosphere, which is considered as the cause of the inspissation of oils. In this phænomenon, therefore, I could observe only an effect of light.

But in what manner did it act? Was it by combining with the oil the pure air contained in the empty part of the vessels? or was it by combining itself with the oil, in a manner never before observed or suspected?

Light, such as it appears to our senses, possesses, no doubt, in consequence of its great velocity, the same properties as caloric (fire), which has not yet been found to possess gravity; but, in combining with the matter, would it not add to the gravity of the latter? It was necessary to make new experiments on this subject. I did so; and though the results of them were foreign to the arts, they are so connected with the theory of the object which I undertook, that I do not think them susceptible of separation*.

13th. The experiments which I projected, with a view to fix my opinion in regard to results so singular, seemed likely to give me information at the same time respecting the cause of the difference observed in the density of the products of the first distillation of the essence, and which may be seen in the table (7). This table gives to No. 1, which contains the first product of the distillation, and which consequently ought to exhibit the lightest essence, a specific gravity greater than is found in the other numbers†. This observation rendered it necessary for me to be more circumspect in the manner of extracting the products of the distillation which I intended to make. Besides, I considered it as a point of importance to ascertain the specific gravity of the products twenty-four hours after the operation.

I therefore distilled forty ounces of common essence of turpentine, the product of which I divided into eight equal parts; the first six, of four ounces, and the last two, of six ounces each. I took care to regulate the heat in such a manner as not to render it necessary to remove

* See the *Journal de Physique* for March 1798; where the subject is treated in new points of view, and in a more extensive manner.

† It is possible that this difference might depend merely on the heat employed for the distillation: but I entertained an idea that it might more particularly arise from my occasionally removing the dome of burnt clay, which I took from the retort when the vapours appeared to be too violent.

the dome, the use of which accelerates the escape of the vapours.

These ethereous products were afterwards exposed to the influence of the solar light, their specific gravity being first ascertained by a test bottle capable of containing an ounce of distilled water, the thermometer being at 55 degrees of Fahrenheit. The details are exhibited in the following table:

Table of the specific gravity of the products twenty-four hours after distillation.

Order of the numbers.	Particular characters of the products.	Their specific gravity as compared with that of distilled water.
No. . . 1	Colourless, but nebulous in consequence of a little water interposed between the parts of the oil . .	gros. 6 . . grains. 66½
2	Colourless, light, and very limpid	6 . . 66
3	The same	6 . . 66
4	The same . .	6 . . 66½
5	The same	6 . . 66¼
6	The same . . .	6 . . 67
7	The same	6 . . 67 full
8	Nebulous, with a striking odour of bitumen not found in the preceding, & of an ambery colour. This product was accompanied with 6 drops of acid water, which had coloured the part of the oil in contact.	6 . . 68½
	The residuum of the distillation was thick, and weighed about 3 ounces.	
	N. B. The common oil of the shops had a greenish tint before distillation, its specific gravity was . .	6 . . 68
	None of these oils attacked copal.	

14th. April 1st 1787, three days after this examination, I closed exactly with pieces of fine cork the bottles which contained the different portions of oil, numbered in the order in which they had appeared in the course of the distillation. I exposed them in the seat of a window which for six months of the year received the solar rays three or four hours daily, and during the same time a strong reflected light. The oil in these bottles was exposed, therefore, to the influence of the direct and reflected solar rays; but it received them only through a window, which preserved it from all external accident.

The paper inscribed with the number of each flask was pasted to it in such a manner that its upper edge corresponded exactly with the level of the essence contained in the vessel, and only one-sixth part of each of these vessels was empty.

15th. On the 30th of March 1788, after a year's exposure, I again examined on the spot these separate portions of essence, and put them into a balance, that I might compare their present specific gravity with that which they had indicated the preceding year.

Nos. 1, 2, 5, 6, and 7 had experienced no decrease in their volume; because they had been completely closed. No. 3 had decreased half a line in a surface an inch in diameter; and No. 4 three quarters of a line.

The vessels marked Nos. 1 and 2 were lined above the level of the essence, with a beautiful vegetation of crystals nearly an inch in length, which crossed each other in every direction. They adhered to the anterior part of the neck of the flask, opposite to that which received the direct solar rays. I thought there was reason to conclude that these crystallizations might have been formed under the protection afforded to them by a plain square of paper, which preserved the empty part of the flasks from the direct action of the light and of caloric.

No. 8, which was in part sheltered by the angle formed by the frame of the window, exhibited also very beautiful crystals, which adhered only to that part of the glass the least exposed to the direct rays. This second observation gave weight to my first conjecture.

The flasks having been inverted and kept in that position for some hours, Nos. 3, 4, and 8 suffered a little oil to ooze from them, in consequence of their being badly stopped.

The stoppers were tinged internally of a pale-yellow colour, as they would have been by weak nitric acid. Their texture, however, was very little altered. This colour, which arose from the impression of an acid vapour, was observed only in the part which had been in contact with that vapour, and did not extend to the interior part of the cork.

The thermometer was exactly at the same point at which it had been the preceding year, that is to say, at 54½ degrees; but the consistence of the oil was no longer the same. The two last numbers exhibited even a slight shade of colour, which they did not possess before the distillation. I shall here present a table of the differences observed in the specific gravity of these different portions of the same oil, after the interval of a year, in order that they may be more easily compared; and I shall add a column pointing out the additional weight which each measured ounce of oil acquired by the effect of the solar light. The test bottle was always the same; that is to say, it contained the volume of an ounce of distilled water at the temperature already mentioned.

A comparative table of specific gravity.

Order of the matters.	Characters of the oils.	Specific gravity observed in 1787.		Specific gravity observed in 1788.		Increase of specific gravity.
		gros.	grains.	gros.	grains.	
No. 1	Limpid and colourless oil . .	6	66½	7	37¾	43¼
2	The same . .	6	66	7	39½	45½
3	More fluid than the preceding, & colourless . . .	6	66	7	33	39
4	Very fluid and colourless . . .	6	66½	7	24½	30
5	Oily, limpid, & colourless . . .	6	66¾	7	38½	43¾
6	Exceedingly oily, limpid and colourless	6	67	7	50¼	55¼
7	Exceedingly oily and limpid, colour somewhat ambery . . .	6	67	7	47½	52½
8	Oily and limpid, but ambery . .	6	68½	7	38	41½

N. B. All these oils applied to copal in relative proportions, according to their density, effected a solution of it, and formed beautiful varnish, except Nos. 3 and 4, in which the copal was precipitated.

It may readily be perceived, that the addition to the specific gravity is here in the direct ratio of that of the density acquired during the exposure of the oil to the solar light. Nos. 6 and 7 serve to confirm the following physical truth; namely, that among homogeneous liquors, and oils in particular, of a different specific gravity, those which are densest possess also the greatest refractive power; and, consequently, are the most capable of accumulating the luminous rays.

This principle being laid down, if a greater accumulation of light be admitted in the latter, there is reason to believe that the result ought to be a new combination; and it is in this combination that we ought to look for the cause of the increase observed in the specific gravity, and in the density of our oils.

No. 8 would have exhibited the same phænomena as Nos. 6 and 7, had it not experienced from the stopper the same inconvenience as Nos. 3 and 4, which showed a sensible diminution of their volume. I have already said (14), that by inverting the bottle it lost its oil, through a fault in the cork. This observation, for which I was indebted to chance, led me to the discovery of a phænomenon too striking to escape the attention of those who cast their eye over the comparative table of the specific gravities: it is seen that the increase of it took place also in the direct ratio of their less evaporation. No. 3, which had lost only half a line of its volume, showed also, in the increase of its density by the influence of the light, nine grains more than No. 4, which exhibited a diminution in its volume of three-fourths of a line*. The numbers which gave

* The paper index of the bottle No. 8 would, no doubt, have shown a sensible diminution. But presuming on too light grounds, perhaps, that this portion of essence could not be employed for

access to the external air are exactly those which showed the least specific gravity.

16th. It is impossible to admit as the cause of this increase the evaporation of the most ethereous and most volatile parts of the oil. There was no sensible decrease in the vessels 1, 2, 5, 6, and 7; and these numbers showed the greatest increase in the density of the oil which they contained. A simple comparison of facts will be sufficient to show the falsity of this supposition. If we admit, according to the result, an addition to the real specific gravity of No. 7, which contained six ounces of essence, we shall find 325 grains added to the specific gravity of the preceding year. These 325 grains make 13 deniers and 3 grains, the deduction of which from the whole mass of essence would have made a deficit in its first volume of three lines, as I ascertained by experiment.

This increase, then, can be explained only by an addition produced under the influence of the light; but whether this fluid, notwithstanding its extreme rarity and great velocity, undergoes any particular modifications, or causes the oily bodies exposed to its direct influence to undergo them, is what I will not pretend to determine. These experiments have discovered to me one fact, which I believe to be new. The influence of light is observed here in a very sensible manner; but what is the nature of this influence? Does it enable the oxygen gas contained in the atmospheric air to overcome the obstacle opposed to it by the best cork

varnish, on account of its colour, I took out two ounces of it for another purpose. The index then was of no use.

stoppers, in order that it may combine with the oil? or does it materially concur itself to produce this phænomenon? These questions deserve further research.

In regard to the supposed combination of the oxygen gas extracted from the atmospheric air, it will appear in this case contrary to the evidence of the results. Nos. 3, 4, and 8, which really lost part of their substance, in consequence of their being incompletely shut, and which for the same reason afforded access to the external air, ought to have presented results agreeable to this supposed combination. We however know them to be contrary; since the essence they contain is specifically lighter than that of the other numbers. This observation will hold good also in regard to No. 8, which containing an oil more refringent than Nos. 1, 2, and 5, ought on that account to acquire a greater density than Nos. 3 and 4, which were under the same circumstances.

I am inclined to believe that the results observed in Nos. 3, 4, and 8, are not to be ascribed so much to the introduction of the external air as to the difficulty experienced by the light, in commencing and bringing to perfection its particular mode of combination in the oily vapour which occupied the empty part of the vessels,—a vaporous combination which the elevated temperature of the solar rays, or that of the atmosphere, expelled before their union with the mass of the oil.

I, however, offer this idea as mere conjecture: to ascertain the truth of it would require a great many comparative experiments, made with vessels, some full, and others half full; but all hermetically sealed.

To determine the effects of the oxygen gas or essence of turpentine, I arranged, in the month of August 1787, an apparatus, the results of which I shall examine at the end of a year. I can, however, assert that I have had sufficient time to observe phænomena which justify the opinion I have advanced in regard to the combination of light with the vapour, and in the vapour of the essence*. Nothing now remains but to deduce the consequences which arise from this series of researches.

General consequences and conclusion.

17th. The object of these researches, as already seen, was to verify a fact, known no doubt to some chemists, but which artists contest,—namely, the solubility of copal in an oil lighter and less coloured than fat oils,—in a word, in essence of turpentine.

The result of the experiments here detailed shows that this essence is the fittest liquor for making copal varnish; that an elevated temperature is not required to favour the process, since it is below that of boiling water. Mere stirring is even sufficient in summer. If the simplicity of this method be compared with that employed in the operation of uniting copal with fat oils, which cannot unite with it but when it is in a state of liquefaction, by the effect of a very high temperature, much superior to that of boiling water, it

* The experiments detailed in the memoir already mentioned (*Journal de Physique, Mars* 1798) leave no doubt in regard to the combination effected in the vapour itself, when the vessel is exposed to the direct influence of the sun.

will be allowed that the liquor which can dispense with this forced liquefaction, which is even satisfied with a temperature of from 88 to 100 degrees, aided by simple mechanical motion to effect that union, is the best of all for the intended purpose.

But these experiments show also in their results, that essence of turpentine does not always exhibit the qualities requisite for effecting this union. We have seen (9 and 15) that ethereous oil had absolutely no action on copal; that its dissolving property was manifested in the ratio of its density (5, 6, and 8); that this density is altogether independent of the rectification of the oil by a second distillation, which in general gives only a light ethereous oil, if the operation is managed with care; or an oil, the specific gravity of which does not exactly follow the order of the division of the product (4 and 7); that the light alone, by the effect of a particular combination, the mode of which can only be presumed, becomes the principle of this density, so essential to the solution of the copal (7, 8, 13, 14, 15 and 16), that this essence of turpentine, which at the moment of its rectification has exercised no power over the copal, may by the mere effect of the influence of the light dissolve, after a certain time, the pulverized copal which has been precipitated from it untouched; that the copal even increases its energy, since the essence can dissolve a larger quantity of it than when it is exposed alone, and without any mixture of copal, to the same influence of the light (5, 6 and 8).

These results prove also, that the more the essence of turpentine is disposed to be decomposed, and to furnish acid water, in the course of the distillation, or during the time of the process for making the varnish, the less proper it is for the solution of copal; because this free acid does not fail to react on the oil, and to communicate to the whole mass a tint, which it ought not to possess (11); in a word, that this oil is susceptible of giving a concrete volatile acid salt, contained in certain balsamic substances (1, 2, and 15). The existence of that salt, which places turpentine among the balsams, according to the new definition of Fourcroy, was at this time unknown.

Some authors assert that they have been able to dissolve copal in essence of turpentine: this chemical property of essence, however, was considered as very problematical. The remembrance of it even seemed to be preserved only in consequence of the merit of the authors who admitted the possibility of it. Two persons of great celebrity have entertained opposite opinions on this subject. Lehmann, whose name is well known in chemistry, asserts that copal is soluble in essence*. Watin, an ingenious artist, refutes this

* "Copal, with oil of turpentine, gives a varnish which in a great measure is similar to amber varnish. The first doses are one part of copal and four parts of the oil of turpentine, which is then added in greater quantity, without determining the weight, in order to dilute the varnish and render it fluid." See *Recherches Historiques et Chimiques du Copal, Mem. de l'Academie de Berlin, tome ix.* See also *L'Art de faire les Vernis, &c. par Watin, edit. de* 1772, p. 162.

This is the first author who mentions the solution of copal in essence of turpentine. As Watin did not succeed, he expresses doubts which, though not accompanied with any explanation, sufopinion, and maintains that it is not soluble *: both, however, are in the right, since this solution depends on a degree of density which the essence sometimes exhibits, and which it may have accidentally exhibited to Lehmann.

18th. The solubility of copal in oil of turpentine being once established, nothing remained but to make use of the observations scattered throughout this essay, in order to discover the speediest, and at the same time the most proper, method for making varnish with essence.

There was reason to think, that by dividing the products of one distillation of this essence into seven or eight parts, it might be possible to discover in these divided parts those which would exhibit the qualities requisite for completing the solution; but it was ob-

ficiently show that he had strong reasons for not considering the results announced as bearing the stamp of rigorous exactness. *See his Reflections*, p. 106.

The author of *Traité sur la Composition des Vernis en général, edit. de Paris* 1780, mentions also, on the authority of mere tradition, the solubility of copal in essence; but he says nothing of the state of the oil. *See page 4 et seq.*

* "It appears proved in practice, I mean the practice of such persons as myself, that neither alcohol (spirit of wine) nor essence can dissolve copal nor amber." See *Art de faire les Vernis, &c. edit. de* 1772, p. 111. The last edition of 1782, which I have just received, confirms the same opinion in the article of Reflections, p. 279. "Copal dissolves neither in spirit of wine nor in any essence, whether in a mass or in powder, but it dissolves in fat oils." *See the same work*, p. 37. "Copal will never dissolve in essence of turpentine." Page 8, in the notes which allude to the faults of the *Parfait Vernisseur*.

served that this process at length gave a contrary result (13); since it often deprived the essence of the shops of that property which it might have acquired from time, or from any other circumstances. This distillation, however, is indispensably necessary when colourless varnish is required; because the essence of the shops is always more or less coloured. Besides, this operation, which may be performed on a large scale in manufactories, furnishes a very simple method of obtaining the most ethereous essence, the use of which I have recommended in the composition of varnish destined for valuable paintings *.

If the distillation of essence be undertaken with a view of accomplishing both these objects at the same time, it must be performed by means of a sand bath, taking care to cover the retort with a dome of burnt clay†. From a hundred ounces of this oil ninety are extracted; the first forty of which, forming ethereous oil of turpentine, must be reserved for the composition of varnish destined for pictures. The last fifty ounces of essence are applied to the composition of copal varnish. The residuum even is not lost; it serves for grinding and mixing up oil colours. If too thick, it is diluted with new essence.

From ten to twelve grains of pulverized copal are mixed with an ounce of the essence destined for varnish, and the mixture is shaken, immersing the matrass in a bath of boiling water. If the copal readily dissolves in the essence, new doses are added; and this is con-

* See the Third Genus, No. XII. p. 133.

† See the description of this process, 2d method, p. 70.

tinued till the essence refuses to take up any more. It sometimes happens that this essence gives immediately a very beautiful varnish and of a good consistence; at other times it refuses every kind of union. In the first case the varnish is filtered through cotton, after it has been allowed to deposit the untouched portions of the copal: in the second, that is to say, when the copal resists the essence, the matrass is closed with a cork stopper, and exposed to the solar light until the essence has acquired an oily consistence. It will assume this state the more easily, the greater the quantity of copal it holds in solution. The influence of the light gradually manifests itself on the essence, and the precipitated portion of the copal decreases, and at length disappears entirely. The consequence is, that the essence acquires from this matter, which is mixed with it, a new consistence and character, which dispose it to become charged with a greater dose of the resin; and in this manner to constitute a real varnish. This has been observed in the sixth section.

Essence prepared in this manner ought to be preferred to the other vegetable oils, which approach nearest to the same state of density or of specific gravity. The varnishes, indeed, which result from the union of it with resins are less fat and of a more drying quality than those made with oil of lavender, oil of thyme, oil of rosemary, &c. employed directly or with some intermediate substance. They are also exceedingly durable when copal forms the basis of them; and they produce the most beautiful effect on metals and polished wood. Copal varnish made with essence has a slight amber colour, which disappears after it has been applied. The oily character, which contributes to its solidity, disposes it to become much better charged than alcoholic varnishes with those vegetable, resinous and metallic colouring parts with which the variety of colours that enrich transparent enamels can be imitated. It may be readily conceived, that to preserve the transparency of varnish, and to give it that lustre which completes the illusion, none but colouring matters entirely soluble in essence must be employed.

It was proper to detach from these particular observations, and even from this part of the work, every thing relating to the use of colouring substances, and the different purposes to which copal varnish made with essence may be applied: a treatise therefore on this subject will be found in the second part of the work which follows.

PART THE SECOND.

ON THE

PREPARATION OF COLOURS,

AND THE

METHODS OF APPLYING THEM,

IN THE

DIFFERENT KINDS OF PAINTING, &c.

TREATISE ON VARNISHES.

PART THE SECOND.

CHAPTER I.

Historical account of the nature of the colouring substances used in painting, with a description of the processes employed to extract them, and of the methods of preparing or modifying them.

The account given in the first part of this treatise, of the substances which concur towards the composition of varnish, must tend to regulate the application of them in a more certain manner. To this advantage may be added that of rendering artists familiar with the different processes which art employs to extract or to modify productions which nature exhibits to us only under fixed and determinate characters. Our knowledge of an art ought not to be confined to what relates merely to manipulations, which are more or less varied by long practice: it ought to be extended also to every object subservient to it.

The composition of the colouring substances, which forms the subject of this second part, requires more extensive and more varied processes, the theory of which cannot be understood without some preliminary knowledge. In regard to these substances, we shall follow the same course as that adopted in treating of the matters employed in the composition of varnishes. It is, therefore, of importance that our observations on the principles of colours, and the effects of their mixtures, should be preceded by an historical account of the substances charged with colouring parts, and by a view of the means which art employs to transfer, under some particular circumstances, the colouring principle of one body into another; or to communicate to it new qualities, which render it capable of extending the wonderful power of combinations. Nothing seems better calculated to make the artist and the amateur sensible that no art is independent, and that all lend to each other reciprocal assistance, which concurs towards their improvement, and often even to the celebrity of the individuals who have sufficient strength of genius to soar beyond the usual beaten track.

Bougival white.

Painters often employ white matters for grounds. Ceruse is distinguished by great durability. It forms an excellent priming, proper for receiving other colours; but there are a great many cases, particularly in painting in distemper, which admit the use of a more common and less expensive white, such as that of Bougival, Spanish white, white of Troye, &c.

Bougival white takes its name from the place where it is extracted, which is near Marly, at the distance of a few leagues from Paris. It is a sort of very fine marly earth. Normandy, Auvergne, and many other districts, contain beds or strata of a white earthy matter, commonly known under the name of tobacco-pipe clay.

This earth, when very white, is much better for house painting than any other white earth of a calcareous nature, such as chalk. The celebrated Wedgewood, who has established a very large manufactory of earthen ware, which in elegance and beauty is equal to the finest porcelain, was exceedingly nice in his choice of this clay, some of which he obtained from Normandy. If similar establishments require that purity should be united to whiteness in the clay employed, the same rigour is not necessary in painting. Body and whiteness are the principal characters required. If Bougival white is not a pure clay, it possesses that whiteness which assigns it a conspicuous place in the order of colouring bodies.

It is sold in the shops under the form of oblong cakes, into which it is cut, after the small stones and sand mixed with it have been separated by washing.

Washed chalk is often substituted in its stead; but connoisseurs have no need of analysis to detect this fraud. Washed chalk gives less body to painting than clay, and does not unite so well with oil when applied to that kind of painting.

According to some experiments which I made with Bougival white, sent to me from Marly, this marl contains nearly a third of carbonate of lime (chalk). This mixture renders it inferior in oil painting to real Spanish white, and to white of Moudon.

Cremnitz white.

The composition of Cremnitz white, in regard to the nature of its base, seems still to be very uncertain.

Three substances, which have nothing in common but the name [illegible] them, are sold under this denomination. [illegible] experiments, which I made on specimens obtained from different colourmen, did not justify the idea entertained by some celebrated painters, that this white is merely an oxide of tin* (calx of tin). In seve-

* I shall embrace the opportunity afforded by the occurrence of the term *metallic oxide*, to give a short view of the theory which establishes this expression in the room of the word *calx*, employed formerly to denote certain metallic preparations.

According to the principles of the Stahlean chemistry, the name of calx was given to every metallic substance which, in consequence of being subjected to the action of fire, exchanged its consistence and metallic brilliancy for a new pulverulent form, coloured or not coloured, according to the nature of the substance; and according to the degree of heat experienced. The name calx was given also to the same substances, when reduced to powder by acids, or when precipitated from their solvent by another substance which seized on the solvent. It was in consequence of this convention that the general denomination of calces was given to litharge, minium, ceruse, white lead, calcined lead, calcined tin, and all metallic substances precipitated from acids by the means of alkalies, &c.

Direct experiments, conducted with great sagacity by Lavoisier, and repeated by a great number of chemists, have freed chemistry from the shackles of the old school. Combustion, and the inflammation of substances which are susceptible of these two states, have no longer been considered as the term of destruction: on the contrary, in the hands of the chemist they have produced all the signs and real characters of new chemical combinations. The evidence of these combinations is so striking, that it will no longer admit the use of the old theory, nor allow us to confound metamorphoses, which metallic substances undergo by the action of heat and the concurrence of oxygen, with that which calcareous earth and stones of the same kind experience from accumulated caloric ral specimens purchased in different shops, I found oxide of bismuth (calx or magistery of bismuth); and

(ardent heat). It is well known that the latter substances are reduced to a real calx (lime) by the loss of a little water; and of a particular acid which was long distinguished by the name of fixed air, because it gave them their state of consistence; but which is now called carbonic acid, since the decomposition of it has shown that its base consists of carbon or charcoal.

Becker, and Stahl his disciple, as well as the old school, placed metallic substances in the class of compounds. They considered them as so many bases united to a particular subtile principle, which produced metallic brilliancy, and which they denoted by the name of *phlogiston*. The action of fire was exercised only on this principle, which it separated from its base, and the latter then assumed the earthy and pulverulent form. This principle being admitted, every metallic calx was merely the result of the mediate or immediate application of fire; it was the metal destitute of *phlogiston*, which communicated to it the brilliancy and consistence it possessed before the operation.

This first hypothesis ought to have given birth to another, serving to explain how a substance, which lost one of its essential principles by the action of caloric (fire), should nevertheless acquire an addition of $\frac{1}{10}$th to its real weight.

But this is not the place for enlarging on the subject in question. I shall, therefore, content myself with observing that this theory, irreconcilable in regard to the most essential points, has given place to a doctrine which, neglecting hypothesis, establishes its foundation only on facts. It admits that metals belong to the class of simple substances; that they are combustible; and that in every case of their exposure to fire, instead of losing, they acquire a new element, which from simple converts them into compound substances. This additional principle or element is the base of pure air or oxygen, and the union of oxygen with caloric (fire) constitutes oxygen gas, which composes, at the least, the fourth part of the atmospheric air.

in two particular cases oxide of lead (ceruse). It did not appear that any of them contained oxide of tin.

Other experiments, undertaken with a view to ascertain the composition of acids, have proved by their results that the same oxygen, the union of which with caloric constitutes oxygen gas, known formerly by the denomination of pure air (vital air), is also the acidifying principle, and consequently the generator of acids. On account of this property the new chemists agreed to give it the name of oxygen, of which the word *oxide* is a derivative. Every metallic substance, therefore, which when exposed to a high temperature abandons its consistence, its tenacity, and its brilliancy, to assume the characters of a substance pulverulent by the addition of oxygen. the base of vital air, which has served for the combustion, ought to exchange its old name *calx* for that of *oxide*. Hence the expression *oxide* of lead, *oxide* of tin, *oxide* of copper, iron, bismuth, &c.; because in this case these metals are oxidated by oxygen, which exists in them in the pure state, and not in that of gas.

The heat being increased, it at length favours the combination of the oxygen contained in the air with the metal, and reduces it to a metallic oxide: but acids furnish, from their own substance, the oxygen necessary for oxidation; and it is the speedier as the acid is more disposed towards the combination.

All these particular effects are connected with the general theory of combustion, the principal result of which is the combination of oxygen, the base of pure air, with the combustible body.

From these observations the reader will be enabled to comprehend easily the theory of the reduction of metallic oxides. This reduction cannot take place but when a combustible body such as charcoal is applied to them, under the influence of a very high temperature. The oxygen contained in the metallic substance, which it converted into an oxide, joins the combustible body, by the effect of elective affinity, and forms with it carbonic acid (fixed air), which escapes: the metal being then abandoned reappears with its former properties.

Two of these specimens seemed to be mixed with a great deal of chalk. The Cremnitz white, which contained this mixture, was in cakes of about two or three inches square, and different in thickness; but it never exceeded an inch.

Cremnitz white, made with bismuth oxidated by means of nitrous acid, or in any other manner, ought to possess no advantage over that which has lead for its basis. It is more liable to be altered by the impression of the light, and of the vapours which arise from stagnant water, privies, &c.

Composition of a white colour, to which I give the name of Cremnitz white.

I found means to make a beautiful pearl white, which I call Cremnitz white, with the oxide resulting from the rapid solution of tin in nitric acid (pure aquafortis), to which was added a fourth part of the sublimated oxide of zinc (flowers of zinc), and an eighth of white clay, extracted from Briançon chalk washed in distilled vinegar *. This mixture, when thoroughly

When the term metallic oxide, therefore, occurs in the chapter on colouring substances, or elsewhere, it is always to be understood as substituted for the word *calx*, which has no relation with the present theory of chemistry

* To prepare Briançon white, select the whitest specimens, and rasp them with a piece of the skin of the sea-dog. Put the powder into a jar, with a quart of good vinegar for every pound of the powder: stir the mixture daily for two weeks, and decant the vinegar without agitating the deposit: then pour clean water over the deposit, and, having stirred it, throw the whole upon a filter, by which means the water of the first washing will be separated.

washed, dried, and sifted through a silk sieve, gave a very white powder of a mean gravity; and so secure from all changes effected by the impression of the light and of vapours, that no composition of this kind can be compared to it. It is certainly too expensive for house painting; but it may be useful for objects which require other processes than those employed in common. It would, no doubt, be attended with great advantage in painting pictures.

Were it necessary to substitute any other metallic substance, lead ought to be preferred to bismuth. Lead rapidly dissolved in nitrid acid (aquafortis) is precipitated in a white oxide, which resists in a sufficient degree the impression of the light, but less so than tin. Those who wish to avoid the trouble of purifying Briançon chalk may substitute in its stead very pure Morat or Moudon white.

Spanish white.

Spanish white is a pure clay, which may be washed in vinegar to separate such calcareous parts as are mixed with it. But this process ought to be employed only

Continue to pour more water over the sediment on the filter, till the water which passes is found to be insipid. Then spread out the filter with the sediment on a hair sieve, sheltered from dust, and dry it till it appears under the form of a white powder. The vinegar here separates from this argillaceous matter all the soluble parts, which might alter its unctuosity; and particularly the ferruginous particles which are often mixed with it.

The division of Briançon chalk may be effected by pounding it in water, which must be frequently decanted when it contains only the fine parts.

in particular cases, when it is necessary to have it exceedingly pure. Its argillaceous nature contributes to the solidity of the ground, when it is employed in oil painting or for varnish. It acquires body; but in these cases it must be used very dry, like all other earths. When moist, their union with oil and varnish is imperfect: they granulate under the brush.

Rolls of washed chalk, which possess none of the qualities required in Spanish white, are often sold in the shops under the same denomination.

The difference, however, between real Spanish white and the chalk attempted to be sold in its stead, may be easily ascertained. Nothing is necessary but to pour upon the specimen a few drops of nitric acid (aquafortis), or of strong vinegar. If the Spanish white be pure, there will be no effervescence; if an effervescence takes place, it is owing to a mixture of chalk. In this case, take some small fragments of the white and immerse them in half a glass of vinegar: if they disappear entirely with effervescence, the whole is calcareous; if any part remains, it will be argillaceous. The quantities of each of these earths may then be estimated merely by the eye.

Gypsum.

Gypsum is a natural combination resulting from the union of the sulphuric acid (oil of vitriol) and lime (the base of calcareous earth). It is a sulphate of lime. When subjected to calcination it is exceedingly useful in the arts. In this state it is employed in building, and in decorations for apartments. It is used also with constant success in agriculture.

Plaster when mixed with water, in order to be cast in moulds, is subject to certain rules. To give it proper consistence the water it has lost by calcination is sufficient. If too large a quantity be added it weakens its force, prevents it from acquiring body, and renders it what is called drowned plaster.

In preparing it to be employed as a white colour in house painting, it ought to be drowned with a great deal of water. This superabundance of liquid keeps all its parts separated, and favours the required division. When divided in this manner it forms a very valuable article for whitewashing apartments, and for painting in distemper.

The last operation is very simple. When diluted with a great deal of water, stir the mass with a broom, and suffer the powder to be precipitated. Decant the supernatant water as soon as it is clear; then wash the matter a second time, and dry the sediment after the liquor has been poured off.

This white is exceedingly fine, and more delicate than that of chalk when the calcined gypsum is pure; that is to say, without any mixture of clay.

Plasterers do not hesitate to substitute this whitening in the room of ceruse, which is not superior in beauty, but which is more durable and dearer. When too thick a coating is applied, it rises in scales; which is not the case when ceruse is employed.

White of Moudon or of Morat.

For some years past we have obtained from the Pays-de-Vaud, in Switzerland, an argentine, silky white, of an exceedingly fine grain, to which we give the name of Moudon or Morat white; because both these towns are in the neighbourhood of the place where it is extracted. It is a real Spanish white, a pure clay, which is employed with success in our manufactories of paper-hangings. Our druggists often sell it as an absorbing earth, under the name of nitrous panacea, and even under that of magnesia; though it stands the action of acids without giving the least signs of effervescence. This earth would afford a great resource to a manufactory of ceruse: when united to that oxide it forms, in oil painting, pearl or dark grays, which are durable and possess great lustre.

WHITE LEAD.

White oxide of lead by vinegar.

White lead is an oxide (calx) produced by the means of vinegar.

The process employed for the preparation of it is the same as that used in preparing oxide of lead, commonly known under the name of ceruse. Lead readily suffers itself to be attacked. Common air exercises an action on it, and covers it with a whitish dust, which is nothing else than an imperfect oxide of lead. This substance may be observed on large edifices covered with lead; but the oxidation when left to nature is too slow to supply the wants of the arts; and for this reason a more expeditious process is substituted in its stead. It consists in exposing plates of lead to the fumes of vinegar.

The jars are half filled with vinegar, and the plates of lead, either rolled up or flat, are suspended over the surface of the acid. The jars are then covered, and being placed on a sand bath, a heat is maintained sufficient to cause the vinegar to throw up fumes, which circulate around the metallic plates. These vapours, being of an acid nature, exercise an action on the lead, penetrate into it, and convert it into a white substance called white lead. These plates are removed when it is observed, on breaking them, that the whole lead is converted into oxide, and that no more traces of the metal remain. When these plates are dried they become very solid.

Various other processes are employed for the same purpose, but they all conduct to similar results. Some manufacturers place these jars in warm dung, and leave them there twenty or thirty days without examining the state of the lead. They then take them out, or scrape them, to remove the oxidated part of the metal; after which they expose the remaining part to new fumes of vinegar, and continue this operation until the whole of it is converted into oxide. This operation, however, is applied in a more particular manner to the fabrication of ceruse; for when it is necessary to prepare that white lead sold in cakes, and not in the form of conical pieces, the plates are exposed to the fumes of vinegar till they are entirely oxidated.

Other manufacturers dispose their vessels in such a manner as to favour a distillation. They cover their jars with capitals, in the form of an alembic, and apply a sufficient heat to distil the vinegar. The distilled vinegar is then kept in reserve for the preparation of acetite of lead (sal saturni). In this process the vinegar acts with more energy, and the lead is completely oxidated and in much less time.

When the vinegar distilled in this operation is employed for the purification of acetite of lead (salt of lead or sal saturni), the same quantity of common vinegar is put into the jars, to supply the place of that which passes over in distillation. But if the distilled vinegar is not destined for any other purpose, it is put again into the jars as soon as a certain quantity of it is found in the receivers.

White oxide of lead, when purchased in cakes and not in the form of powder, is free from any alteration; but it is not uncommon to find in the interior part of these cakes small plates of lead in the metallic state.

Painters, who do not grind their own colours, are often discouraged by the gray tint which white lead assumes under the muller. This effect, which is merely accidental, lessens their confidence in it, and renders them uncertain in the choice of their white. If the white oxide of lead still contains particles of lead not oxidated, this metallic part becomes divided by the motion of the muller, and renders the colour gray. Artists, therefore, ought first to ascertain whether the white lead is pure, and to select those cakes which are thinnest. Besides, the porphyry and the muller ought to be perfectly clean; because this oxide, which often contains a little acid moisture, is more disposed than any other matter to attract parts resulting from preceding operations of grinding. To obtain it of a fine quality, it ought to be ground several times. It is often preserved under water in earthen-ware or glass vessels; but, for the most part, it is kept in the form of small pieces of a conical shape.

If form be considered as a matter of indifference, the white, newly ground, is spread out on strong paper, in a thin stratum: when dry it is removed in scales, and preserved in that state in vessels well closed, to defend it from the contact of every kind of vapour.

This oxide is lead penetrated by oxygen, which abounds in the acid of vinegar; but it does not contain enough of developed acid to be considered as a salt. It is reserved, in general, for delicate painting. This substance, which I shall call white oxide of lead, stands better than that obtained by the following preparation.

Ceruse. Oxide of lead by vinegar.

When a manufactory is established for the preparation of ceruse, less precaution is employed in the exposure of the plates of lead than in the preparation of white lead in cakes. The plates are also thicker; because the oxide is scraped off as it is formed. When a certain quantity of it has been collected, it is laid on a flat stone placed in a horizontal direction, and is ground by means of a muller fixed in a vertical position, which is made to turn round. The oxide is mixed with a little tobacco-pipe clay, or with Spanish white;

and when the mixture is well kneaded under the muller, the whole paste is divided into small conical cakes, which are dried in a stove, or in the open air, according to the season or the situation of the manufactory. Each cake is wrapped up in paper, and tied with a piece of packthread. It is under this form that it is sold in the shops.

If any doubts are entertained of such mixture being genuine, a comparison which may easily be made between the very high price of white lead, which requires no subsequent preparation, and the very inferior price of ceruse, which must undergo a more tedious process immediately after it is removed from the influence of the acid fumes, will be sufficient to show the effect of adulteration. White lead, indeed, costs three times the money that ceruse does.

Manufacturers are not always scrupulous in regard to the choice, nor even the quantity, of the earthy substance which they mix with the oxide. Some employ Spanish white, or exceedingly white tobacco-pipe clay, and adhere to certain doses, which they never exceed; but others employ white of Troyes, or washed chalk, which they add even to excess. These differences, resulting from operations on a large scale, which are subject to no inspection for the security of commerce, render it necessary to be careful in the purchase of ceruse. The heaviest, under a given volume, as well as that which does not effervesce when an acid is poured over it, ought to be preferred. Chalk does not give to painting the same whiteness and the same body as white clay.

Besides these adulterations, practised in large manufactories, others are practised in the retail shops, which however may be detected. A second mixture of chalk is added; but in this case the ceruse is sold in powder, and not under the form of cakes. This fraud, therefore, may be avoided by purchasing no ceruse except that wrapped up in the manner in which it comes from the manufactory. The most certain indication of another mixture of chalk is the higher price asked for ceruse in cakes than for that in powder, notwithstanding the additional labour, and the loss occasioned by pulverization.

Of these two preparations of lead, ceruse only is employed in the application of varnishes used for valuable furniture and for pictures; but painters are acquainted with other substances which may be substituted in its stead.

The Dutch once engrossed this kind of manufacture entirely; but within these few years new manufactories have been established in England, France, and Italy. Some Marseillese have established one at Leghorn since the revolution; and two or three years previous to the conquest of Tuscany were sufficient to confirm its success.

This oxide, dissolved again in vinegar, and made to crystallize, gives acetite of lead (salt or sugar of lead).

Rouen white.

Rouen white is a kind of marl (clay and carbonate of lime or calcareous earth), which is mixed with water to separate from it the sandy or coarse particles. The water is decanted, while still charged with the lightest matter, which forms a sediment by rest. When this deposit has acquired the consistence of a paste, it is taken out, and divided into small masses of about a pound weight each.

The mixture of chalk (carbonic acid united to lime) with clay renders the latter less fit than if pure for painting in oil, or for varnish. This white, however, is better for that purpose than the white of Troyes.

White of Troyes, white chalk.

White of Troyes is a carbonate of lime (carbonic acid united to lime), known commonly under the denomination of chalk. It takes its name from the town near which it is found, and where it forms beds of considerable extent.

This white is often mixed with portions of sand, silex (common flint), and other impurities, from which it must be freed. This is accomplished by washing, as already described in the article on Rouen white. This white is sold under the form of large square cakes, weighing ten or twelve pounds each, and of rolls and cylinders of from sixteen to twenty ounces. It is cut also into long square sticks, to give it the appearance of tobacco-pipe clay, none of the qualities of which it possesses. This is a fraud which may be easily detected by means of strong vinegar, which, with chalk, produces an effervescence; but which has no action on tobacco-pipe clay, nor on real Spanish white.

The use of chalk for the common white-washing of apartments is generally prevalent; but gypsum is far superior. It serves also for different grounds, either coloured or not, which are applied in distemper. It is rendered more durable by being mixed up with size. But if it be employed as priming, destined to receive colouring parts, the washing it is subjected to in the manufactories is not sufficient: it must be made to undergo the same operation a second time, when not separated from those parts which escape washing on too large a scale. The application of it in the preparation of paper hangings is prejudicial to certain colours, and particularly to Prussian blue. Chalk carefully washed is not attended with the inconvenience of altering and destroying the colours.

The first advantage arising from large manufactories is the œconomy which may be introduced into every branch of them; and particularly in regard to the number of workmen. When a common matter is employed, pulverization by the hand becomes very expensive. A mill or a turning muller will perform, in a few hours, what could not be accomplished by several workmen in the course of as many days.

In the operation here alluded to, the matter is placed on a flat stone, in order to be pulverized by a vertical muller, which revolves in that position. Washing completes the separation of the parts most attenuated from those which still require some more revolutions of the muller, if the matter be received in a close hair sieve. It is treated with a large quantity of water, and the mixture is stirred with a clean broom. A sediment is speedily formed by a little rest. The supernatant water is reddish: when the water has been decanted, the deposit, for the greater security, is mixed up with a new quantity of the same liquid, and as soon as a sediment is formed it is separated in the same manner. The precipitate acquires the consistence of a paste, which is divided into small portions to facilitate its desiccation. This matter when washed, as here described, exercises no action on compound colours; and Prussian blue (prussiate of iron), according to the account of an ingenious manufacturer of paper hangings, experiences no more change from it. Carbonate of lime (chalk), which has not been washed, produces the same effect on prussiate of iron as an alkali or lime would do. This affords a new subject of research in regard to this kind of manufacture.

White of Troyes, or chalk, is proper only for painting in distemper. With oil and varnishes it becomes brown; and with the latter it has the inconvenience of splitting. Besides, it is not fit for priming, like clay mixed with a little ceruse. Colours which admit chalk have no lustre, for want, perhaps, of the second washing; and they are not durable, even though the chalk may be mixed with a little ceruse.

White of zinc. Sublimated oxide of zinc. Calx of zinc. Flowers of zinc.

The discovery of a white colour, unalterable by the impression of oil, light, and vapour, has long been a desideratum to painters. All the known compositions of this kind were attended with the inconvenience of assuming, after a certain period, tints different from those which the artist was desirous of fixing. A brownish or yellowish appearance destroyed the effect, and left the painter very far short of what he intended. Works of genius ought to survive in their full glory the perishable hand of the artist, by whom they have been successfully executed. It was, therefore, doing a real service to painting, to ensure the hopes of the great masters repecting one of those colours which are chiefly employed by them in their compositions.

Guyton de Morveau thought he should be able to discharge this task reserved to chemistry, by substituting sublimated oxide of zinc (flowers of zinc) for the oxides of lead and bismuth (white lead and calx of bismuth), the use of which was attended with discouraging inconveniences. For this purpose he employed the utmost care in the establishment of a manufactory of the sublimated oxide of zinc, in order that he might give effectual assistance to the art of painting.

Metallic colouring substances have at all times been considered by painters superior in one point to earthy matters, and to those extracted from the vegetable kingdom. They unite much better with the oil used in mixing them up, and they produce, under the influence of the light, more extensive effects, as well as mellower and better maintained tones, in consequence, no doubt, of their solidity and particular texture. In this respect the application of the oxide of zinc to the subline kind of painting, formed an acquisition the more valuable as it completely superseded the necessity of using other oxides; which, for very good reasons, ought long ago to have been confined to common painting and house-painting.

In arts which require long experience, before it is possible to form a correct judgment in regard to new processes, the desired end can be attained only by degrees. Some painters find this oxide of zinc too dry; and, in consequence of this prejudice, they choose rather to expose themselves to inconveniences which they have always dreaded, but with the limits of which they are acquainted, than undertake trials which they fear still more, because they are ignorant of the bounds of their results. Routine very often multiplies difficulties: at any rate it does not seem calculated to remove, nor even to lessen them. We are inclined to believe that in the present case it is more powerful than reason. Time alone can determine what advantages will be derived from the use of this oxide. In similar cases comparative trials overcome all difficulties, and exhibit every thing in its proper light. The trials, therefore, may be varied, by comparing the effects of this oxide with those of the two oxides in some measure proscribed, and those exhibited by that kind of Cremnitz white the composition of which I have already described. The process is easy, and may be performed by any one. It may even be varied in regard to the addition of white clay.

Sublimated oxide of zinc is obtained by fusing that metal in an earthen tube, which performs the office of a crucible, and which is placed obliquely in a reverberating furnace, or in any other capable of producing a heat sufficient to make it enter into fusion. The metal then soon inflames, and emits thick white fumes, which, if the zinc be pure, are converted into very white woolly flakes. These flakes, which adhere to the sides of the tube, are called sublimated oxide of zinc (flowers of zinc).

If the zinc contains iron, the oxide is of an orange-yellow colour: the metal is purified by throwing into it, while in fusion, some pinches of the flowers of sulphur.

Azure. Enamel blue. Saffer blue. Saxon blue. Vitreous oxide of cobalt.

Painters make use of a vitreous matter, which derives its blue colour from the oxide (calx) of a metallic substance called cobalt.

It is manufactured on a large scale in Saxony, where mines of cobalt are abundant. From this circumstance only it has acquired the denomination of Saxon blue.

Cobalt is not produced by nature in a state of purity. It presents itself to the miner mixed with earths and stones, united to sulphur or arsenic, and often to both. These, however, are not the only matters from which it ought to be separated; its ore contains, for the most part, bismuth, nickel, and silver. The working of it is attended with many difficulties, which render it necessary to multiply the processes. The first operation is that of roasting. The ore is broken, to separate it from the stones; and the fragments abundant in ore are placed apart, in order to be subjected to calcination. Those which contain a great deal of stony matter are carried to the stamping mill. As this pulverization is effected in running water, the water carries with it the stony parts, which are lighter than the ore, while the latter remains partly in the trough, and partly in the first reservoir. The pounded ore is then dried, and afterwards roasted.

Roasting is performed by causing flame to be reverberated on the matter. The part which supports the ore has the form of a very flat spheroidal segment, in the middle of which is a cavity shaped like a crucible, to receive the bismuth, which proceeds thither on the first impression of the caloric (fire). During the oxidation (calcination) of the cobalt, the sulphur and arsenic are volatilized; the first under the form of sulphuric and sulphurous acid gas, and the second under that of oxide of arsenic. The latter, in becoming sublimed, covers with white and black flakes the whole interior part of a long gallery.

When the cobalt ore has been roasted to the proper degree, it assumes the colour of wine lees. It is then mixed with four or five parts of silex (common flint) pounded in a mill, after it has been brought to a white heat, and quenched in cold water, that its parts may more easily be divided. This mixture, known under the name of saffer, is employed by potters mixed with a portion of an alkaline salt, as a blue colour for their earthen-ware.

Azure, enamel blue, Saxon blue, smalt, or *vitreous oxide of cobalt*, is saffer reduced to blue glass by the action of a violent fire. The more the glass is charged with oxide of cobalt, the intenser the blue colour becomes. This vitrification is facilitated by the addition of a certain quantity of carbonate of potash (alkali of potash), or carbonate of soda (effervescent alkali of soda).

Smalt, or the vitreous oxide of saffer, reduced to coarse powder, is distinguished by the name of coarse Saxon blue, or enamel blue. Some pretend that it is four times fused and pulverized, after it has been poured in a liquid state into a certain quantity of water.

This blue is employed in oil painting, and in some kinds of distemper.

This vitreous oxide of saffer requires great care before it can be applied to delicate kinds of painting. It must be ground for a very long time; and as the glass is exceedingly hard, this mechanical labour, to many painters, is highly disagreeable. It is destined for drapery of a soft blue colour; but it is attended with the fault of being somewhat dry, and this is owing to the vitreous nature of its composition, which prevents it from adhering to the canvas, and from forming a body with other colours. Were it not for the tenacity of the oil, which serves it as cement or varnish, it would fall into dust.

The great consumption which the Genevese artists make of blue extracted from cobalt, and the difficulty they have often experienced to obtain it of a degree of fusibility suited to the delicacy of enamelled articles, have sometimes obliged them to prepare the oxide themselves from the ore. It was for their use, in particular, that I have detailed the processes employed for that purpose.

Ultramarine.

Ultramarine is extracted from *lapis lazuli*, or azure stone, a kind of heavy zeolite, which is so hard as to strike fire with steel, to cut glass, and to be susceptible of a fine polish. It is of a bright blue colour, variegated with white or yellow veins, enriched with small metallic glands, and even veins of a gold colour, which are only sulphurets of iron (martial pyrites). It breaks irregularly. The specimens most esteemed are those charged with the greatest quantity of blue.

It is found in Asia, particularly in Persia, and in the kingdom of Golconda. A beautiful kind of it is brought also from Siberia, Prussia, and Spain; but it is not so hard as that of Asia. The Romans, who set a great value on this stone, rendered it so common in Italy that it has been employed for mosaic painting: in a word, they extended the use of it so much, that they introduced it by way of decoration in their buildings with the same profusion as common marble. The Jesuits, who carried on a great trade with it, contributed not a little to make it subservient to the luxury of the arts.

The operation of extracting ultramarine from *lapis lazuli* having been much encouraged by the excessive price given for this truly valuable colour, the abundance of it has occasioned a considerable diminution of the stone which produces it. This inconvenience has been followed by another. The present price of ultramarine is superior to that of gold. It is even probable that it will still increase in proportion to the scarcity of the stone, which has become greater since the suppression of the order of Jesuits, and by the dispersion of it in consequence of the general revolution which has taken place in the political state of the ecclesiastical dominions.

Several artists have employed their ingenuity on processes capable of extracting ultramarine in the greatest purity. Some, however, are contented with separating the uncoloured portions of the stone, reducing the coloured part to an impalpable powder, and then grinding it for a long time with oil of pinks. But it is certain that, in consequence of this ineffectual method, the beauty of the colour is injured by parts which are foreign to it; and that it does not produce the whole effect which ought to be expected from pure ultramarine.

The most beautiful ultramarine and the richest in colour has, over the best prepared Prussian blue, the invaluable advantage of uniting in a natural manner with the fine carnation of beauty. It is superior to Saxon or enamel blue in the richness and mellowness of its tone. It is not sandy like Saxon blue; it never deceives by the effect of time the hope of the artist who has applied it. In this point of view alone it is worth a greater price than has been fixed on it.

When considered, therefore, in its full splendour, and with all its attributes, it is rather a production of art than of nature. At any rate, if nature performs the first part, art disengages it from all substances foreign to its composition, and makes it appear with its most valuable characters.

It may be readily conceived, that these eminent qualities must have induced those first acquainted with the processes proper for increasing the merit and value of it to keep them a profound secret. This was indeed the case. Ultramarine was prepared long before any account of the method of extracting and purifying it was known. The first writer who speaks of it is Anselm de Boot, who describes the preparation of it in his Treatise on Precious Stones. After him, Kunckel and Neumann, who employed themselves on the same processes, speak of them also, but without entering into minute details. They were satisfied with giving the most essential observations necessary to facilitate the complete extraction of the colouring part.

Kunckel separates from the stone the most apparent parts of the ultramarine; reduces them to the size of a pea, and, having brought them to a red heat in a crucible, throws them, in that state, into the strongest distilled vinegar. He then grinds them with the vinegar, and reduces them to an impalpable powder. He next takes a quantity of wax and colophonium, equal to that of the lapis lazuli, that is to say, an ounce or half an ounce of each of these three substances; melts the wax and the colophonium in a proper vessel, and adds the powder to the melted matter; then pours the mass into cold water, and leaves it eight days at rest. He next takes two glass vessels filled with water so hot that the hand can scarcely bear it; kneads the mass in the water; and when he concludes that the purest part of the ultramarine has been extracted, he removes the resinous mass into the other vessel, where he finishes the kneading to separate the remainder. The latter portion appeared to him to be much inferior, as it was paler than the former. He then leaves it at rest for four days, to facilitate the precipitation of the ultramarine, which he extracts by decantation, and washes, no doubt, in pure water.

According to the remark of this author, ultramarine of four qualities may be separated by this process. The first separation gives the finest: as the operations are repeated the beauty of the powder decreases.

Kunckel considers immersion in vinegar as the essential part of the operation. It facilitates, no doubt, the division and even the solution of the zeolitic and earthy particles soluble in that acid.

Neumann's process is much shorter. He first separates the blue parts, and reduces them, on a piece of porphyry, to an impalpable powder, which he besprinkles with linseed oil. He then makes a paste with equal parts of yellow wax, pine resin, and colophonium, that is to say, eight ounces of each; and adds to this paste half an ounce of linseed oil, two ounces of oil of turpentine, and as much pure mastic.

He then takes four parts of this mixture, and one of lapis lazuli, ground with oil on a piece of porphyry, mixes the whole warm, and suffers it to digest for a month. At the end of that period he kneads the mixture thoroughly in warm water, till the blue part separates from it, and at the end of some days decants the liquor. This ultramarine, he says, is exceedingly beautiful.

These two processes are nearly similar, if we except the preliminary preparation of Kunckel, which consists in bringing the lapis lazuli to a red heat, and immersing it in vinegar. It may be readily seen, by the judicious observations of Margraff on the nature of this colouring part, that this calcination may be hurtful to certain kinds of azure stone. This preliminary operation, however, is a test which ascertains the purity of the ultramarine.

As this matter is valuable, some portions of ultramarine may be extracted from the paste which has been kneaded in water. Nothing is necessary but to mix it with four times its weight of linseed oil; to pour the matter into a glass of a conical figure, and to expose the vessel in the balneum mariæ of an alembic, the water of which must be kept in a state of ebullition for several hours. The liquidity of the mixture allows the ultramarine to separate itself, and the supernatant oil is decanted. The same immersion of the colouring matter in oil is repeated, to separate the resinous parts which still adhere to it; and the operation is finished by boiling it in water to separate the oil. The deposit is ultramarine; but it is inferior to that separated by the first washing.

Method of ascertaining whether ultramarine be adulterated.

As the price of ultramarine, which is already very high, may become more so on account of the difficulties of obtaining lapis lazuli, the sources of which seem to have been nearly exhausted, it is of great importance that painters should be able to detect adulterations, which the spirit of avarice introduces into all articles of value. Ultramarine is pure if, when brought to a red heat in a crucible, it stands that trial without changing its colour. As small quantities only are subjected to this test, a comparison may be made, at very little expense, with the part which has not been exposed to the fire. If adulterated, it becomes blackish or paler.

This proof, however, may not always be conclusive when ultramarine of the lowest quality is mixed with azure or Saxon blue; but if it be mixed with oil, it is found to have very little body compared with its brightness. It is well known that vitreous matters, such as azure, exhibit no more body than sand ground on porphyry would do: ultramarine treated with oil assumes a brown tint.

If the painter is satisfied with enjoying in its full plenitude a present of nature exceedingly valuable to his art, without any desire of knowing the principles of its composition, the case is not the same with the naturalist and the chemist. The more valuable an article appears to be, by the service which it renders to the arts, the more worthy they consider it of research.

This colouring matter, therefore, did not fail to excite the curiosity of chemists. Some, guided by particular results, ascribed it to copper. Others, by extracting a few grains of silver from certain kinds of lapis lazuli, thought themselves authorised to ascribe the colour of it to that metal. Margraff, a celebrated chemist of Berlin, asserted that it was indebted for it to iron in a particular state. The sulphates of iron (martial pyrites), which often heighten the splendour of this substance, afford some reason for admitting in it this metal: Klaproth is of the same opinion. Does it exist in it under the form of prussiate of iron (Prussian blue) modified by a mixture of earthy principle? The truth of this conjecture can be ascertained only by direct experiments. C. Guyton read in the National Institute, in the year 1800, some observations on the colouring principle of lapis laxuli, which seem to show that it arises from a particular combination of iron and sulphur. He was led to this conclusion by the result of an experiment made, in a strong heat, with a mixture of charcoal-powder and gypsum, coloured red by iron. Though the artificial ultramarine which this chemist extracted from it did not answer the expectation of eminent painters, it is still a discovery highly interesting to theory. Perhaps it might be substituted for prussiate of iron, which many painters employ, but without placing much confidence in it.

Prussian blue. Prussiate of iron.

Prussiate of iron (Prussian blue) is the result of a combination of iron with an acid of a peculiar nature, distinguished by the name of the Prussic acid.

The discovery of this blue, like many other things, was the mere effect of chance. Dippel, a chemist of Berlin, having thrown into his court-yard several liquors which he considered as of no further use, or in order to free his laboratory from them, observed with surprise that some of the stones were covered with a very bright blue colour. He then recollected that he had before thrown out, in the same place, the remains of a solution of sulphate of iron (martial vitriol, green vitriol); and as these liquors were of an alkaline nature, and had been repeatedly employed for the rectification of oil of hartshorn, he thought he had now found the key of a discovery which appeared to be of great importance. He therefore directed his researches towards this object, and, after some successful experiments, found means to compose Prussian blue by a sure process.

At the commencement of the eighteenth century chemistry was merely a science of results. The theories applied to a certain aggregate of these results were often the mere offsprings of the imagination. Macquer, the celebrated author of the Dictionary of Chemistry, seems to have fixed for ever the ideas of chemists in regard to the prussiate of iron, by supposing the alkali completely saturated with a particular matter, which he calls the *colouring matter of Prussian blue*, and which, from the characters of its union with the alkali, he supposed to be of an acid nature.

Animal analysis, which has been so much extended under the reign of the pneumatic chemistry, was at that time covered by an impenetrable veil. The part, at least seen by chemists, was confined merely to detached and unconnected fragments. As this colouring matter exercised its action only under the cover of combination; and as it eluded all direct researches, and every method employed to effect a separation of it; the public opinion was divided respecting it till its nature was ascertained by the ingenious experiments of Macquer.

By uniting prussiate of potash (alkali saturated with the colouring part of Prussian blue) and a solution of sulphate of iron (martial vitriol), he observed the effects of a double decomposition and a double combination. The Prussic acid (the colouring part of Prussian blue) abandoned the alkaline base to join the iron, which it converted into Prussian blue; while the sulphuric acid, which existed in the sulphate of iron, joined the alkali, to form sulphate of potash.

This particular substance, before distinguished by the name of the colouring part of Prussian blue, is therefore an acid; and in the new Nomenclature is called the Prussic acid. Its union with iron forms prussiate of iron (Prussian blue), and its affinity for that metal is so great that the strongest mineral acids cannot separate them.

Alkalies and lime take it from iron. These substances become saturated with it; and in this state of saturation they can regenerate the prussiate of iron, when its favourite metal, combined with an acid, is presented to it. This circumstance is indispensably necessary to effect the double decomposition and double combination observed by Macquer.

It was reserved for one of the first chemists of modern times to penetrate further into the mystery in which this singular combination was still involved. Berthollet employed himself in researches on Prussian blue; and it results from his experiments that the prussic acid is a combination of azote, hydrogen, and carbon, the proportions of which are not yet known*.

* According to the new nomenclature, that part of atmospheric air which is neither fit for respiration nor combustion is named azote. It forms three-fourths of atmospheric air, and

When prussiate of iron is pure, its volume does not decrease in acids, nor does it acquire a more intense colour. When it loses part of its volume, and acquires greater strength of colour, this indicates a mixture of alumine (the base of alum), which is often introduced into its composition. In this case, to obtain it pure, it must be treated with muriatic acid (marine acid), and washed with clean water: it is then thrown on a filter to separate the water from it; after which it is dried.

This colouring substance participates with many other productions of art in the inconveniences resulting from operations on an extended scale. Its colour is not uniform and constant. Common prussiate is of a pale blue colour, and sometimes exhibits even a greenish tint. The mixture of alumine (alum earth) will serve

exists in it in the state of gas, by its union with caloric. Oxygen gas, known formerly by the name of pure air, constitutes about one-fourth part of atmospheric air, without including the accidental mixture of other gaseous fluids.

The base of the fluid distinguished formerly by the name of inflammable gas is now called *hydrogen*. When united to caloric it becomes *hydrogen gas*. This expression has been substituted for the former, since the discovery of the decomposition of water, of which it is a component part.

Carbon, according to Berthollet, is common charcoal freed from the hydrogen and oxygen which were united with it.

These different elements abound in the animal organization. It needs therefore excite no astonishment, if alkali exposed to heat with animal substances should become saturated with these principles, which the fire modifies in such a manner as to form of them a new acid, without the concurrence of oxygen, which seems to reserve to itself the privilege of acidification.

to explain the first effect; but the shade of green depends on the state of the prussiate of potash, which is not completely saturated with prussic acid. In this case the free alkaline part, that is to say, the portion not occupied by the acid, precipitates a relative quantity of the sulphate of iron, in the state of yellow oxide, the mixture of which with the true blue of the prussiate gives rise to a compound colour, which is green. This oxide of iron is easily separated by immersing the prussiate in muriatic acid (marine acid).

Prussiate of iron acts a distinguished part in house-painting, and even in other kinds. It is, however, often attended with one inconvenience. When ground with oil it assumes a yellow tint, which some great masters correct by a little violet lake. This yellow tint seems to arise from the action of the oil. Another fault which seems to confine the use of this colour is, that the blue it produces is hard, and does not seem to harmonize with that fine carnation which gives charms to the physiognomy when artfully intersected by beautiful veins. Ultramarine alone answers this purpose when employed by the hand of an artist.

Artificial Saxon blue made with prussiate of iron.

Saxon blue may be successfully imitated, by mixing with a divided earth prussiate of iron at the moment of its formation and precipitation.

Into a solution of 144 grains of suphate of iron (martial vitriol) pour a solution of prussiate of potash (alkali of potash saturated with prussic acid). At the time of the formation of the prussiate of iron add, in the same vessel, a solution of two ounces of sulphate of alumine (alum); and pour in, at the same time, the solution of potash,—but only in such a quantity as may be supposed necessary to decompose the sulphate of alumine; for a dose of alkali superabundant to the decomposition of that salt might alter the prussiate of iron. It will, therefore, be much better to leave a little alum, which may afterwards be carried off by washing.

As soon as the alkaline liquor is added, the alumine precipitated becomes exactly mixed with the prussiate of iron, the intensity of which it lessens by bringing it to the tone of common Saxon blue. The matter is then thrown on a filter, and after being washed in clean water is dried. This substance is a kind of blue verditer, the intensity of which may vary, according to the greater or less quantity of the sulphate of alumine decomposed. It may be used for painting in distemper.

Blue verditer.

Nature presents, in certain parts of copper mines, a blue colouring matter which is known by the name of *malachite*. For the most part it is found in solid masses, but sometimes in crystals. By pulverization it acquires nearly the appearance of that powder which painters call *blue verditer*. It is a natural oxide of copper: but, however fertile nature may be in producing it, the great consumption made of blue verditer leaves no doubt that this matter, which was formerly procured from Germany, and which is now obtained from England, is a result of art, in which the copper is brought to a degree of oxidation not always easy to be imitated.

It was long imagined that blue verditer was the product of a preparation, in which lime, muriate of ammonia (sal ammoniac), and copper, dissolved by a mineral acid, were acting and constituent parts. This, at least, was the opinion of Rouelle junior, a man justly celebrated in chemistry.

It was reserved, however, for his learned colleague Pelletier to unite the synthesis and analysis he had given of it, and to discover the circumstances which promote or oppose, during the time of the operation, the development of the blue colour. An interesting detail of the various processes he employed, to procure to his country the fruits of a new manufacture, may be seen in the Annales de Chimie*.

Most of the metallic oxides obtained by precipitation contain, besides a portion of oxygen, a considerable quantity of carbonic acid, (formerly called fixed air, an union of oxygen and carbon). From the results of Pelletier's experiments, it appears to be proved, that the colour of the crystals of mountain blue or malachite, and that of blue verditer, cannot be ascribed to a combination of the oxide of copper, lime, and carbonic acid, but rather to a certain degree of the oxidation of the copper. This theory, if I recollect, corresponds exactly with that given by Morveau, some years before, to explain the cause of the difference of the colour of mountain blue and green.

* Vol. xiii. p. 47.

Every precipitation, therefore, of copper, or every hyper-oxygenated natural oxide of copper, such as mountain green or malachite, will not give blue when treated with lime, but will always remain green. In the process employed to make blue verditer, the lime, according to the remark of the author, seems to act on the oxygen contained in the precipitate, and to diminish the proportions. It is to this particular circumstance that we are indebted for the conversion of the blue colour into a green colour, which is constant in precipitates of copper.

The process for the composition of blue verditer seems, on the first view, to be simple; the success of it, however, is often the fruit of long practice. As too circumstantial details are not suited to a work of this kind, I shall confine myself to the most essential points of the operation. An expert chemist may easily supply the rest.

Dissolve the copper, cold, in nitric acid (aquafortis), and produce a precipitation of it by means of quicklime, employed in such doses that it shall all be absorbed by the acid, in order that the precipitate may be pure copper; that is to say, without any mixture. When the liquor has been decanted, the precipitate is washed, and spread out on a piece of linen cloth to drain. If a portion of this precipitate, which is green, be placed on a grinding stone, and if a little quick-lime, in powder, be added, the green colour will be immediately changed into a beautiful blue. The proportion of the lime added is from seven to ten parts in a hundred. As the whole matter has already acquired the consistence of paste, desiccation soon takes place.

A quintal of blue verditer, prepared in this manner, gives the same proportions as those discovered by Pelletier in the component principles of the best English blue verditer, which are:

Carbonic acid - - - - -	30 parts.
Water - - - - - - - -	$3\frac{1}{2}$
Pure lime - - - - - -	7
Oxygen - - - - - - -	$9\frac{2}{3}$
Pure copper - - - - - -	50
	100

Blue verditer is proper for distemper and for varnish; but it is not fit for oil painting, as the oil renders it very dark. If used, it ought to be brightened with a great deal of white.

Green verditer.

Green verditer does not require the same care in the preparation. It is the general result of the precipitation of copper, dissolved in the nitric acid (aquafortis), effected by means of chalk or a white marl. In the latter case, the divided clay, which forms part of it, gives pliability to the verditer, when employed as a colour. If too much charged with copper it would not be fit for oil painting, as the oil would produce too dark a green. In this case it must be corrected by the addition of a little ceruse or Spanish white.

This colour, however, is much better calculated for distemper; and the painter may supply its place in oil painting with verdegris mixed with two or three parts to one of ceruse. With very slight dose of verditer the lightest shades of sea-green may be represented.

Cinnabar. Vermilion. Red sulphurated oxide of mercury.

The metallic combinations which constitute the greater part of ores depend on a kind of operations which nature performs in silence; which she varies, and which it was reserved for the modern chemistry to discover. Cinnabar, that natural combination of sulphur and mercury, affords a specimen of these results. Seven parts of mercury and one of sulphur form that brilliant needly mass, of a beautiful red colour, the brightness of which depends on proper proportions of the two component principles, as well as on the greatest possible division of them. Cinnabar, indeed, assumes a very high colour only under the muller. When divided in this mechanical manner, it exchanges the name of cinnabar for that of vermilion.

Nature rarely exhibits this substance in large masses and crystallized. In this respect art is superior, since it prepares it in large masses, and endowed with all the required qualities. It is manufactured chiefly in Holland.

The sulphur is liquefied in large earthen jars, or in iron pots, and the mercury is mixed in the proper doses. These two matters become heated to such a degree, by the mere effect of the combination, as to inflame; and when this result takes place the cinnabar is more easily sublimated, because the excess of sulphur is destroyed. The matter when cold is pulverized, and made to sublimate in flat earthen vessels, which are covered by other vessels of the same substance. These sublimating vessels are arranged in long sand furnaces called galleries, where the sublimation is effected only by a very strong heat.

If the first sublimation does not produce cinnabar capable of displaying, when ground, a beautiful colour, the matter is subjected to a second sublimation, the effect of which is to destroy the quantity of sulphur greater than that essential to the most perfect combination in regard to the tone of colour required in vermilion.

The splendid colour of the vermilion employed for carriages is owing to this composition. It is employed also for painting other articles; for colouring sealing wax, and, in general, for all ornaments which require a high strong colour agreeable to the eye: of course, it is proper for painting of every kind.

Vermilion has no rival but carmine, which, though it produces a mellower and duller colour, is no less pleasing to the eye.

Naples yellow. Yellow oxide of lead mixed with white oxide of antimony by nitre.

It is not long since the nature of Naples yellow was known. It was formerly believed to be of volcanic origin; and arsenical qualities were ascribed to it, in consequence of its yellow colour, which gave it some resemblance to orpiment; and on account of the green colour communicated to it by iron and steel. This effect, generally known to painters, renders it necessary in grinding this colour to employ porphyry and an ivory spatula.

All these uncertainties, however, were at length cleared up by the chemical discovery of this composition, the secret of preparing which was in the possession of a Neapolitan far advanced in life. Without dwelling on the circumstance of the age of the person who possessed this secret, and the extensive use made of this preparation, which is fit for painting of every kind, without excepting enamel and porcelain painting, great merit is to be allowed to the researches of Fougeroux, who found means to give to this composition a certain effect.

The possessor of the secret mixed calcined lead with a third of its weight of antimony, pounded and sifted, and exposed the mixture to a potter's furnace. Fougeroux de Bondaroy obtained the result by modifying the formula in the following manner* :

Composition.

Take twelve ounces of ceruse, two ounces of the sulphuret of antimony (common antimony), half an ounce of calcined sulphate of alumine (calcined alum), and an ounce of muriate of ammonia (sal ammoniac).

Pulverize these ingredients, and having mixed them thoroughly, put them into a capsule or dish of crucible earth, and place over it a covering of the same substance. Then expose it at first to a gentle heat, which must be gradually increased till the capsule is mode-

* Memoires de l'Académie des Sciences 1772.

rately red. The oxidation arising from this process requires at least three hours' exposure to heat before it is completed. The result of this calcination is Naples yellow, which is ground with water on a porphyry slab by means of an ivory spatula, as iron would alter the colour. The paste is then dried, and preserved for use. It is a yellow oxide of lead and antimony.

The author observes, that there is no necessity of adhering so strictly to the doses as to prevent their being varied. If a golden colour be required in the yellow, the proportions of the sulphuret of antimony and muriate of ammonia must be increased. In like manner, if you wish it to be more fusible, increase the quantities of sulphuret of antimony and calcined sulphate of alumine.

I have remarked that sulphuret of antimony, which contains a little iron, like that of Savoy, and sometimes that of Auvergne, and which for this reason assumes after its oxidation a yellow colour, is the most proper for this kind of composition. I have several times supplied this natural want by stirring with a spatula of soft iron white oxide of antimony by nitre (diaphoretic antimony), when in a state of fusion.

A kind of yellow from lead, in cakes half an inch in thickness, the edge of which exhibited a needly crystallization, was formerly brought to us from England. Painters who made use of it knew that muriate of soda (common salt) entered into this composition, the process for preparing which is as follows:

Montpellier yellow. Yellow oxide of lead by the muriatic acid.

C. Chaptal, formerly professor of chemistry at Montpellier, naturalized in France this preparation, by establishing a manufactory of it in his native town. The same process furnished matter for making metallic yellow, and separated at the same time the alkali from the soda, which serves as a base to sea salt. At that period the French government encouraged chemists to make researches respecting the means of obtaining this alkaline salt, at such a price as might enable it to stand in competition with the potash obtained from foreign countries, and to supply its place in the time of war. The proportions, in case of necessity, may be reduced.

Take four quintals of vitreous oxide of lead (litharge), well sifted, which must be divided into four equal portions, and put into as many glazed earthen vessels. Dissolve also one quintal of muriate of soda (sea salt) in about four quintals of water.

Pour a fourth part of this solution into each of the four earthen vessels, to form a paste of a light consistence. Leave the whole at rest for some hours, and when the surface begins to grow white, stir the mass with a strong wooden spatula. Without this motion it would acquire too great hardness, and a part of the salt would escape decomposition.

As the consistence increases, the matter is diluted with a new quantity of the solution; and if this is not sufficient, recourse must be had to simple water to maintain the same state of consistence. The paste is then very white, and in the course of twenty-four hours becomes uniform and free from lumps. It is then suffered to remain for the same space of time, stirring it at intervals to complete the decomposition of the salt.

The paste is then well washed to carry off the caustic soda (soda deprived of carbonic acid) which adheres to it; and to extract the whole of it, the mass is put into strong linen cloth and subjected to a press.

The remaining paste is distributed in flat vessels; attd these vessels are exposed to heat, in order to effect a proper oxidation (calcination), which converts it into a solid, yellow, brilliant matter, sometimes crystallized in transverse striæ. This is Montpellier yellow, which may be applied to the same purposes as Naples yellow.

In this mixture of vitreous oxide of lead with muriate of soda, dissolved in a sufficient quantity of water, the latter salt is decomposed. The muriatic acid abandons the alkali of the soda, which served it as a base, and joins the vitreous oxide of lead, which is converted into muriate of lead; and at length, by the aid of caloric (of fire), into yellow oxide of lead. The soda separated by the washings is caustic, that is to say, pure, and without any mixture of carbonic acid. By leaving it exposed to the air it becomes charged with carbonic acid (formerly fixed air), diffused throughout the atmosphere, and is rendered crystallizable. It is then carbonate of soda (salt of soda). Seventy-five pounds of soda, purer than that of the shops, is extracted from this mixture*.

* See *Journal de Physique*, August 1794.

Indigo.

The East and West Indies, as well as some countries of the American continent, such as Brasil, Peru, &c. produce a plant called by the Spaniards *anillo*, the juice of which, when subjected to spirituous fermentation, gives a fecula of a blue or dark azure colour, imported to us under the form of square flat pieces, not very hard, which float on water: they are inflammable, and when put into the fire are almost entirely consumed.

The best and most esteemed is called Guatimala indigo, from the name of a town in Spanish America, where it is prepared on a large scale, and with the greatest care.

When rubbed on the nail it leaves a trace similar in colour to the antient bronze. This character is always much sought after; and indigo of this kind is called cupreous indigo.

A fecula of a blue or dark violet colour, called also indigo, is brought to us from Brasil. It differs from real indigo by being produced from the leaves of the *anillo*, while common indigo is formed from all the external parts of the plant.

The pulverization of indigo is attended with the same inconveniences as that of certain colouring substances of which clay forms the basis: but the operation may be very much shortened by putting three or four eight-pound shot into a large copper bason with the quantity of indigo intended to be pulverized. A slight circular motion communicated to the bason, held in the two hands over a table, will be sufficient to make the bullets roll over the matter, and to pulverize it much better than if pounded and sifted, as in this case it often forms itself into balls, and does not pass through the sieve.

These two kinds of indigo can be applied only to painting in distemper, with or without varnish. They are not proper for oil painting, because the oil renders them black or green, and they lose in drying a part of the vigour of their tone. In general, indigo is not employed pure: it is always mixed with white; if pure, it would become black. Ceruse, indigo, and a particle of black, if the proper proportions be observed, give a beautiful pearl gray colour. In distemper, indigo is employed for painting the sky, sea, and all the distant parts of a landskip.

The use of indigo is not confined to painting in distemper. When subjected to certain chemical processes, it may be extended to miniature painting. Indigo united to sulphuric acid (oil of vitriol) in the state of a solution, diluted with water, gives to woollen and silk the beautiful and solid colour of Saxon blue. This blue of indigo, and the yellow of indigo produced by nitric acid (aquafortis), when mixed in certain proportions, give a beautiful and solid green, which may be employed in that kind of miniature painting which serves to ornament silk, fans, &c.

These three colours, when intended for paper grounds, must be weakened with water. The mucilage proper for the latter kind of painting ought to be extract, not of gum arabic, but of gum tragacanth, which has more body.

The works which may be consulted in regard to indigo are *Memoires de Quatremere d'Isjonval*, crowned in 1777 by the Academy of Sciences at Paris, and the *Journal de Physique* for July 1777, which gives an abridgment of them.

Of lakes.

Lakes, in general, are produced by the decomposition of sulphate of alumine (alum), by a substance which seizes on the sulphuric acid, and liberates the alumine which served it as a basis. This earth, in precipitating itself, unites to the vegetable or animal colouring fecula, which passes into the bath. It is this colouring fecula, united to alumine, which constitutes the different carminated lakes and crayons. It appears that the word *lac* or *lake* is of Indian extraction, and that it is employed in that country to express a colour, or a solid colouring part: it has therefore a particular acceptation, which has been somewhat generalized in our language.

The preparation of crayons, which has given birth to a particular kind of painting, is not confined to the chemical process above mentioned: there is one simpler and less tedious; it is that which serves as a basis to the preparation of Dutch pinks. It consists in mixing up with the coloured bath an argillaceous matter of the first quality, and subjecting the whole to careful evaporation, or in exposing the liquid paste on driers of plaster covered with a clean cloth, to prevent the crayon from adhering to the drier.

This method is more œconomical than the chemical process; but it requires a very nice choice in the quality of the white destined for the operation, and in particular the precaution of previous washing, to remove the fine sandy parts with which the finest white clays are mixed.

The variety observed in the tone of lakes extends also to their qualities. They are more or less capable of resisting the impression of the air and the light, according to the nature of the substances from which they are extracted. The lakes most in request are those called *carminated lakes*, whatever may be the intensity of their colour, because experience has shown that they oppose the strongest resistance to the destructive influence of the light. Their colouring part is extracted from cochineal, the price of which has increased in consequence of its intrinsic qualities in various preparations employed in the arts of painting, dyeing, and calico printing. They are imitated with colouring parts extracted from certain vegetable substances; but the latter produce only false carminated lakes, as their colouring part is easily altered by the combined action of the air and the light. These colouring parts, however, are still of some use when reserved for temporary objects, as printed calicoes, paper hangings, &c.; but they must be entirely banished from the pallet of the painter who sets any value on the opinion of posterity. The epithet of *carminated*, applied to the valuable lakes, is derived from a series of operations on the composition of carmine, which is prepared from cochineal.

It is not so easy as some have imagined to distinguish whether a lake has really been extracted from cochineal, or from some vegetable colouring substance. Means have been found, by certain re-agents and various mixtures, to give such splendour to inferior lakes that the most skilful painters are often embarrassed in their choice. The dread of employing uncertain colours renders them timid, and often makes them neglect colours the duration of which they cannot foresee. Among this number are lakes. The inefficacy of the means said to be proper for determining their choice in this respect, has served only to increase their uncertainty. If vinegar, we are told, be poured over lakes, the colouring part of which has been derived from Brasil wood or madder, &c. they will instantly turn yellow. We shall soon see how little confidence ought to be placed in processes the results of which require more time than an artist in full employment can devote to them. I have, therefore, thought that this object is of sufficient importance to deserve particular researches: with this view I prepared some real as well as false carminated lakes, that I might subject them to the action of some re-agents, and for this reason I have distinguished each preparation by a number, that they may be more easily indicated in the annexed table, which exhibits the results of comparative experiments. It will be found at the end of this article.

Carmine.

This kind of fecula, so fertile in gradations of tone by the effect of mixtures, and so grateful to the eye in all its shades; so useful to the painter, and so agreeable to the delicate beauty, is only the colouring part of a kind of dried insect, known under the name of cochineal.

A mixture of 36 grains of chouan seed, 18 grains of autour bark, and as much sulphate of alumine (alum), thrown into a decoction of 6 gros of pulverized cochineal and 5 pounds of water, gives at the end of from five to ten days, a red fecula, which when dried weighs from 40 to 48 grains. This fecula is carmine. The remaining decoction, which is still highly coloured, is reserved for the preparation of carminated lakes.

CARMINATED LAKE.

No. I.

The decoction which floats over the coloured precipitate, known by the name of carmine, being still highly coloured, the addition of sulphate of alumine, which is afterwards decomposed by a solution of carbonate of soda (salt of soda), disengages the alumine, and the alumine in precipitating itself carries with it the colouring part of the bath. According to the dose prescribed for the composition two or three ounces of alum may be employed. The greater or less quantity of this substance, the base of which seizes on the colouring fecula, determines the greater or less intensity observed in the colour of the lake resulting from it. When the process is conducted on a small scale, and by way of trial, the precipitate is received on a filter: it is then washed with warm water; and when it has acquired the consistence of soft paste, it is formed into small cakes or sticks. It is this substance which constitutes the beautiful carminated lakes used for crayon painting.

In operating on a large scale, the whole of the alkaline liquor judged necessary after a few trials to decompose the quantity of alum intended to be employed, may be divided into three or four separate portions. As many cloth filters as there are alkaline portions being then prepared, the first portion of alkaline liquor is poured out, and the coloured precipitate resulting from it is received on one of the filters: the coloured liquor which passes through the filter receives the second portion of alkaline liquor, and the latter produces a second precipitate, which is received on a new filter. This operation is then continued till the last portion of alkaline liquor has been employed. The lakes deposited on the filters are washed in warm water; and when they have drained, they are carried along with their cloth to the plaster driers, or to beds of new bricks. These driers, which are made of wrought plaster, in the form of thick basons, or these bricks, attract the moisture of the paste, and shorten the process. The first precipitation gives a carminated lake of a very high colour; the second is somewhat lighter; and the rest go on decreasing in the same manner. By these means the artist obtains from the same bath shades of colour varied without end, much mellower, and more delicate than those resulting from a mechanical mixture of white clay in different doses, and lake saturated with colour by one operation.

If the composer of crayons prefer in these operations to mix the bath of cochineal with white clay, well washed and of the first quality, he may obtain the same shades by diluting with one measure of the decoction of cochineal different quantities of clay. For example, a pound of decoction saturated with colour, and a quarter of a pound of clay; the same quantity of decoction, and half a pound of clay; a pound, and so on. This operation, which is conducted in the same manner as that for Dutch pinks, is speedier than that performed by a chemical decomposition with alum and an alkali. The lakes obtained are exceedingly beautiful; but unless the clay be of the first quality they never have the brightness, softness, and mellowness of the former; as the saline matters employed form a mordant which is not furnished by the second method. In the latter, the washings, which are indispensably necessary to carry off the salt resulting from the new combination, are suppressed.

A beautiful tone of violet, red, and even of purple red, may be communicated to the colouring part of cochineal by adding to the coloured bath a solution of tin in nitro-muriatic acid (aquaregia). The effect will be greater, if, instead of this solution, a solution of oxygenated muriate of tin (fuming liquor of Libavius) be employed.

The addition of arseniate of potash (neutral arsenical salt) gave me shades which would be sought for in vain with sulphate of alumine (alum).

Another method of preparing carminated lake, by extracting the colouring part from scarlet cloth.

Carminated lake may be composed also, without employing cochineal in a direct manner, by extracting the colouring matter from any substance impregnated with it, such as the shearings of scarlet cloth.

Put into a kettle one pound of fine wood-ashes with forty pounds of water, and subject the water to ebullition for a quarter of an hour; then filter the solution through a piece of linen cloth till the liquor passes through clear.

Put the liquor on the fire; and having brought it to a state of ebullition, add two pounds of the shearings or shreds of scarlet cloth dyed with cochineal, which must be boiled till they become white; then filter the liquor again, and press the shreds, to squeeze out all the colouring part.

Put the filtered liquor into a clean kettle, and place it over the fire. When it boils, pour in a solution of ten or twelve ounces of alum in two pounds of spring water which has been filtered. Stir the whole with a wooden spatula till the froth that is formed be dissipated; and having mixed with it two pounds of a strong decoction of Brasil wood, pour it upon a filter. After filtration, wash the sediment with spring water, and remove the cloth filter charged with it to plaster driers, or to a bed of dry bricks. The result of this operation will be a beautiful lake; but it has not the soft velvety appearance of that obtained by the first method. Besides, the colouring part of the Brasil wood which unites to that of the cochineal in the shearings or shreds of scarlet cloth, lessens in a relative proportion the unalterability of the colouring part of the cochineal. For this reason purified potash ought to be substituted for the wood ashes.

In this process the sulphate of alumine (alum) undergoes decomposition by the presence of the alkaline liquor or solution of wood ashes, which is a carbonate of potash. The alumine, in precipitating itself, seizes on the colouring fecula of the cochineal, which the scarlet rags have abandoned to the alkali.

After the operation, the driers of plaster, or the bricks, which have extracted the moisture from the precipitate, are exposed to the sun, that they may be fitted for another operation.

This method is more complex than the preceding. Besides, it is not œconomical for colour-makers who may be at a distance from cloth-dressers. The shearings of cloth are in great request among the manufacturers of paper-hangings, which renders the price of them too high to admit of their being employed in the preparation of carminated lakes. This, therefore, is the only process I never repeated.

Rouge.

Carmine united to talc, in different proportions, forms rouge employed for the toilette. Talc is distinguished also by the name of Briançon chalk. It is a substance composed, in a great measure, of clay combined naturally with silex.

Carmine, as well as carminated lakes, that is to say, those the colouring part of which is borrowed from cochineal, are the most esteemed of all the compositions of this kind, because their colouring part maintains itself without degradation. There are even cases where the addition of caustic ammonia, which alters so many colouring matters, is employed to heighten its colour. It is for this purpose that those who colour prints employ it.

FALSE CARMINATED LAKES, IN WHICH THE COLOURING PART IS DIFFERENT FROM THAT OF COCHINEAL.

Carminated lake extracted from madder.

No. II.

Notwithstanding the unfavourable opinion entertained in regard to lakes extracted from vegetable substances, C. Merinet, an ingenious painter, found in the root of madder a colouring substance to which the addition of sulphate of alumine (alum) gives a very warm tone of purple red, exceedingly bright, and of such durability as places this lake far above that obtained from a decoction of Brasil wood. Such, at least, is the account I have seen of it*.

* Certain saline substances, which chemists and the manufacturers of colours employ as re-agents and mordants, have a very striking influence on several vegetable colouring matters, which they modify in a particular manner that depends on their state of composition. Though experience seems to have limited the number of these re-agents, there is reason to presume that new researches in regard to the numerous saline combinations known in chemistry,

The following process, which I employed to make lake of madder, was attended with complete success. Experience will soon show what are the proper doses of the principal substance and of the re-agents. Boil one part of madder in from twelve to fifteen parts or pounds of water, and continue the ebullition till it be reduced to about two pounds. Then strain the decoction through a piece of strong linen cloth, which must be well squeezed; and add to the decoction four ounces of alum. The tint is then a beautiful bright red, which the matter will retain if it be mixed with proper clay. In this case, expose the thick liquid which is thus produced on a linen filter, and subject it to one washing

and those especially, the base of which is metallic, would still procure new resources to the art of colour-making, cotton-printing, dyeing, &c.

The animal organization, and the motion which constitutes life, give, under certain circumstances, results similar to those observed in certain vegetable or animal colouring matters subjected to the influence of chemical agents. The colouring part of the *cactus opuntia*, on which the cochineal is produced, and on which it feeds, receives, according to every probability, from the insect all those qualities which raise it so far above all the colouring feculæ of the same tone. The case is certainly the same with that of madder, which escapes the operation of digestion when the root is mixed with the food, and which gives to bones as bright a tint as it produces when treated with alum. There is equal reason to presume that the solid colouring matter which fills the alveoli of gum lac, and which the Indians take great care to separate before they sell that resin, is an extract of the substance used as nourishment by the kind of ant which deposits it on the branches of the jujube. All these particular colouring matters receive, no doubt, from the animal humours that solidity of tint which is peculiar to them.

to remove the alum. The lake, when taken from the driers, will retain this bright primitive colour given by the alum.

But if in the process for making this lake decomposition be employed, by mixing with the bath an alkaline liquor, the alum which is decomposed deprives the bath of its mordant, and the lake obtained after the subsequent washings appears of the colour of the madder bath without any addition: it is of a reddish brown. In this second operation seven or eight ounces of alum ought to be employed for each pound of madder.

This kind of lake, obtained by decomposition, is exceedingly fine; but it does not possess that bright red colour so much sought after: it may, however, be communicated to it, if the washed precipitate be mixed before it be dry with alum water.

If the aluminated madder bath be sharpened with acetite of lead (sal saturni), or with arseniate of potash (neutral arsenical salt), you will obtain, by the addition of carbonate of soda, a rose-coloured lake of greater or less strength. It is that marked No. 3. in the comparative table.

Lake from Brasil wood.

No. IV.

Brasil wood affords, for the preparation of those lakes called carminated lakes, two different and very rich colours, if the process which facilitates the removal of its colouring part to the alumine disengaged from the alum, or to proper clay, be varied. These two shades are obtained by employing chemical decomposition, or by plain mixture without decomposition. The two processes I used are as follow:

I boiled four ounces of the raspings of Brasil wood in fifteen pounds of pure water, till the liquor was reduced to a pound and half or two pounds. The liquor had then a dark red colour, inclining to violet; but the addition of four or five ounces of alum gave it a bright red, inclining to rose-colour. When the liquor has been strained through a piece of linen cloth, if four ounces of the carbonate of soda (alkali of soda) be added with caution, on account of the effervescence which takes place, the colour, which by this addition is deprived of its mordant, will resume its former tint, and deposit a lake, which when washed and properly dried has an exceedingly rich and mellow violet-red colour.

If only one half of the dose of mineral alkali be employed for this precipitation, the tint of the lake becomes clearer; because the bath still retains the undecomposed aluminous mordant.

In the last place, if the method employed for Dutch pinks be followed, by mixing the aluminous decoction of Brasil wood with pure clay, such as Spanish white and white of Morat, and if the mixture be deposited on a filter to receive the necessary washing, you will obtain from the driers a lake of a very bright dark rose-colour. The lake which I prepared in this manner, making use of pure clay from Morat, is marked No. 5. in the comparative table.

The first lake is harder than the second, because notwithstanding the washing it retains salts which adhere strongly to the clay; but the second is too soft. Its colour, heightened by the mixture of alum, seems to have a superiority over the aluminous lake of madder, which brings it near to the lakes made from cochineal; since, according to experiments of which I shall here give a short view, it opposes nearly the same resistance to the effect of certain re-agents.

By the same processes a very beautiful lake may be extracted from a decoction of logwood. In general, lakes of all colours, and of all the shades of these colours, may be extracted from substances which give up their colouring part to boiling water; because it is afterwards communicated by decomposition to the alumine precipitated from sulphate of alumine, by means of an alkali; or the tincture may be mixed with a pure and exceedingly white argillaceous substance, such as real Spanish white, or white of Morat. It is the property of alumine, and of all clays, to form a kind of combination with the divided oily or resinous substances with which they are in contact, and to retain them: this property constitutes them stones or earths. Some of them, under the name of fuller's earth, are employed for scouring cloth.

When lakes are prepared by the medium of alum, which is decomposed by the application of an alkaline liquor, carbonate of soda (salt of soda) is to be preferred to carbonate of potash (alkali of potash), because the new salt, which results from the decomposition of the sulphate of alumine by means of the former, is far more soluble than that which might be formed by potash. The washing of the lake then succeeds better, and no foreign salt remains to make it hard, and sometimes efflorescent. Besides, this labour for the greater exactness would require the use of pure carbonate of potash, and it is easier to answer this condition with soda than with potash, though soda is never pure.

Lakes enter into the composition of solid colours. They may be employed to colour changing alcoholic varnishes; but in this particular case it would be simpler to extract the tincture from cochineal itself, since nothing is required but the colouring part.

I have already mentioned, that it has been commonly believed that real carminated lakes, the colouring part of which is obtained from cochineal, can easily be distinguished, by means of vegetable acids, from those in which the colouring part is a vegetable product. The latter, as asserted, do not stand the test of immersion in these acids without becoming yellow. The trials which have been made do not seem to correspond to the confidence placed by some in this kind of process, since artists are still afraid to employ lakes in the composition of works which they are desirous should be handed down to posterity. It is rather the latter consideration, than the fear of a pecuniary sacrifice for an article of inferior value, that ought to excite a wish that means of avoiding this fraud might be discovered. Both these motives, however, induced me to make researches on this subject, by exposing to the efforts of different re-agents the five kinds of lake, the composition of which has been here so minutely detailed, that the processes may be applied to every substance the colouring part of which is soluble in water. I shall here exhibit a comparative table of the effects resulting from the different processes employed. The experiments were made in large watch glasses exposed to the open air; and as the impression of the light has a more sensible influence on some colouring parts than on others, I thought it my duty to subject the mixtures to it.

Re-agents act in a different manner on the same substance. Some, to produce their effect, require only a momentary contact; while others require more time, and do not manifest their influence till they have produced a kind of solution. This circumstance, which I could not properly observe in simple mixtures exposed to evaporation favoured by the sun, induced me to vary the experiments: I put the same mixtures into bottles closely shut, and kept an account of the results observed at the moment of contact, twenty-four hours after, and at the end of three weeks. They are exhibited, such as I observed them, in the annexed table.

This short view of these results will, no doubt, be sufficient to establish the essential differences between the various colouring parts applied to the composition of carminated lakes or crayons; and to prove the insufficiency of the means hitherto considered as the most certain, for distinguishing real carminated lakes from those which are only an imperfect imitation of them. Lemon juice, or any other vegetable acid, and in particular vinegar, to which was ascribed, but without any reason, the property of changing to yellow the bright or purple red given to these counterfeited lakes, and

Comparative Table of t...

Re-agents.	No. 1. Lake from cochineal t..d alum alum and the alkali orat...		
	At the time of mixture.	*Twenty-four hours after.*	*...ree weeks after.*
Caustic ammonia.	Brightened. Not dissolved	The same.	...en colour, ...stroyed. ... dissolved
Acetous acid, or strong distilled vinegar.	The same tint. Not dissolved	Purple.	...eddish ...own. In ... dissolved.
Diluted sulphuric acid.	Bright red. Dissolved.	The same.	...eddish ...own. In ... dissolved.
Muriatic acid.	Dark rose colour. Dissolved.	Rose.	...lnut-tree ...lour. In ... dissolved.
Carbonate of potash.	Dark violet colour. Not dissolved.	Purplish red.	...estroyed. ...t dissolved

Re-agents.	*Comparative ...h.* No. 1.
Caustic ammonia.	Dry lake. Colour pre-...with some and a little less bright abo...
Acetous acid, or strong vinegar.	Dry; and of a rose colou... to brown.
Diluted sulphurous acid.	Aluminous crystals of a...e of thick lour. The lake was cryst...
Muriatic acid.	A kind of transparent s...k red colour beautiful purple colour.

N. B. Carbonate of potash was not emp...

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Comparative Table of the results of the mixture of some re-agents with different carminated lakes, observed at different periods in close vessels.

RE-AGENTS.	No. 1. Lake from cochineal treated with alum and the alkali of soda.			No. 2. Lake from madder with alum decomposed by soda.			No. 3. Lake from madder with arseniate of potash and salt of lead.			No. 4. Lake from Brasil wood with alum decomposed by soda.			No. 5. Red from Brasil wood and alum mixed with earth of Morat.		
	At the time of mixture.	*Twenty-four hours after.*	*Three weeks after.*	*At the time of mixture.*	*Twenty-four hours after.*	*Three weeks after.*	*At the time of mixture.*	*Twenty-four hours after.*	*Three weeks after.*	*At the time of mixture.*	*Twenty-four hours after.*	*Three weeks after.*	*At the time of mixture.*	*Twenty-four hours after.*	*Three weeks after.*
Caustic ammonia.	Brightened. Not dissolved	The same.	The same.	Blood red. In part dissolved.	Brighter red.	A little altered. In part dissolved.	Brick red. Not dissolved.	The same.	Altered. Not dissolved.	Violet purple. Not dissolved	Coffee brown. In part dissolved.	Darker. In part dissolved.	Violet purple. Not dissolved	Violet inclining to brown.	Green colour, destroyed. Not dissolved
Acetous acid, or strong distilled vinegar.	The same tint. Not dissolved	Purple.	Beautiful red. Dissolved.	Chesnut. In part dissolved.	The same.	Dark cinnamon colour. In part dissolved.	Brick red. Dissolved in part.	The same.	Pale red. Dissolved in a great part.	Dark red Dissolved in part.	The same.	Purple red. In part dissolved.	Purple red. Not dissolved	Poppy colour.	Reddish brown. In part dissolved.
Diluted sulphuric acid.	Bright red. Dissolved.	The same.	Pale red. In a kind of jelly.	Dark cinnamon colour. In part dissolved.	Brown colour	Dark walnut-tree colour. In part dissolved.	Yellowish brown. Not dissolved.	Light yellow.	Green colour, & destroyed. Not dissolved.	Bright scarlet. Not dissolved	Bright rose colour.	Bright rose colour. Dissolved.	Scarlet red, a little dull. Dissolved in part.	Purple.	Reddish brown. In part dissolved
Muriatic acid.	Dark rose colour. Dissolved.	Rose.	Purple red.	Brick colour inclining to brown. In part dissolved.	Light brown.	Dark walnut-tree colour. In part dissolved.	Dark orange. In part dissolved.	Darker.	Brown. In part dissolved.	Red inclining to purple. Not dissolved.	Reddish brown.	Dark brown. In part dissolved.	Red inclining to rose colour Not dissolved	Rose inclining to poppy colour.	Walnut-tree colour. In part dissolved
Carbonate of potash.	Dark violet colour. Not dissolved.	Purplish red.	Red of wine lees. Altered.	Dark reddish brown In part dissolved.	Brick red colour, or light brown.	The same. In part dissolved.	Brick red, as by ammonia.	Red chesnut colour. Not dissolved.	The same. Dissolved.	Reddish brown. Not dissolved.	Dark violet red.	Dark reddish brown. Not dissolved.	Dark violet. Not dissolved.	Common violet.	Destroyed. Not dissolved

Comparative results of the mixture of the same re-agents with the same lakes exposed to the air and the sun, observed at the end of a month.

RE-AGENTS.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Caustic ammonia.	Dry lake. Colour preserved below, and a little less bright above.	Dry. Brick colour below, and a little pale above.	Dry lake of a dark brick red colour, a little pale at the surface.	Dry lake, with a surface like talc: a little pale above; colour preserved below.	Dry lake colour preserved, with some white specks above.
Acetous acid, or strong vinegar.	Dry; and of a rose colour.	Dry. Of a reddish brown colour.	Dry. Of a pale brick colour.	Dry. Purple red colour.	Dry. Purple colour inclining to brown
Diluted sulphurous acid.	Aluminous crystals of a pale rose colour. The lake was crystallized.	Kind of soup of a light rust colour.	Dry lake, and of a brown colour.	Thick soup of a bright brick red colour.	Dark red, of the consistence of thick soup.
Muriatic acid.	A kind of transparent saline jelly of a beautiful purple colour.	Kind of jelly of a capuchin colour.	Pulverulent lake of a dark mordoré colour.	Dry lake of a flesh colour.	Kind of thick soup of a dark red colour.

N. B. Carbonate of potash was not employed in these first experiments.

even the mineral acids which I employed, exhibit characters entirely opposite in these colouring parts, which are foreign to that of cochineal. We every where see that the development of the red colour, under different tones of shade, is the certain result of the first contact, except in madder red, which acids speedily destroy. They change this colour to that of rust, more or less dark, according to the time it has been exposed to the acid and to the influence of the light.

These results, when compared, seem to confirm the great similarity between the colouring part extracted from Brasil wood and that of cochineal; since acids contribute to their development in the same tone of colour, though with modifications which may readily be observed. Were one contented, therefore, with the first view in this respect, the progress of our re-agents would appear to be pretty uniform; but it would not be sufficient to establish the necessary distinction between lakes extracted from cochineal and those made with Brasil wood; since with one re-agent, such as sulphuric acid, they exhibit chemical properties which seem to confound them when the effects of the first contact only are considered. This kind of resemblance, however, is limited: it soon becomes weakened by time and the impression of the light; and it is then easy to distinguish them by the subsequent results, on leaving an interval of three or four days to facilitate and complete the action of the re-agents.

Every one of these substances here mentioned becomes then, in the hand of an intelligent painter or amateur, the certain means of enabling him to ascertain the nature of lakes. The effects arising from the application of acids are not sufficiently distinct at the moment of their mixture, though they present shades which do not escape the notice of an expert eye; but an interval of forty-eight hours will be sufficient to render their difference very sensible to persons in the least accustomed to the effect of such mixtures. The sulphuric acid employed in the trials to which I here allude, resulted from a mixture of the sulphuric acid of the shops (oil of vitriol) and water, in the proportion of one to four. The muriatic acid was applied in the state in which it is sold.

If the results be accurately compared, it will be observed that they vary in the mixtures according as they are exposed in open vessels, or in vessels closely shut. In the first case, the evaporation of the liquid may serve to account for the little influence of the re-agent. Caustic ammonia on such occasions produces no effect, in consequence of its great volatility. The muriatic acid participates in the same inconvenience. Besides, the mixture of light bodies transported by the air, or detached from the ceiling of the apartment, may modify the results. A view of the two comparative tables will be sufficient to give weight to the present observation, and to determine in regard to the preference which ought to be given in the employment of these mixtures to vessels which can be closed with cork stoppers. The effects may then be observed with more certainty, and to a greater extent.

Some of the re-agents seize on the base of the lake, and dissolve it. This effect may furnish a new subject of observation, when it is required to discover the nature of that base which may be composed of alumine, resulting from the decomposition of the sulphate of alumine (alum), or pure clay; or, in the last place, of chalk. This solution, then, is better perceived in vessels which oppose the evaporation of the liquid than in those which afford a free access to the exterior air. I have exhibited these particular cases in the comparisons which constitute the first comparative table by the expressions *dissolved*, *dissolved in part*, or *not dissolved*. In all cases the influence of the light is not to be overlooked.

These observations conclude my researches in regard to real or false carminated lakes. They may, perhaps, appear prolix to those who in works of this kind look only for the formulæ of compositions; but it ought always to be remembered that I write for the information of the amateur as well as of the artist.

OXIDES OF LEAD.

GRAY OXIDE OF LEAD. GRAY CALX OF LEAD.

First degree of oxidation.

The oxides of lead obtained by the means of caloric (fire) exhibit themselves in the arts under various characters of difference, which may serve to denote with considerable accuracy the gradation they experience in the process of oxidation, under the continued action of a pretty high temperature. The same gradation ought to be followed in the order of their description.

When lead is exposed to heat, it readily enters into fusion. Its surface then becomes covered with a pellicle of a gray, and as it were an earthy colour: this is the first step towards oxidation (calcination). If this pellicle be removed, it is immediately succeeded by another; and so on till the whole mass is, at length, reduced to the form of a gray powder. This is gray oxide of lead.

MASSICOT. YELLOW OXIDE OF LEAD.

Second degree of oxidation.

After the first operation of the temperature is increased, the gray oxide assumes a yellow colour; and when this colour is sufficiently developed it is distinguished by the name of massicot, or more correctly of *yellow oxide of lead*.

MINIUM. RED OXIDE OF LEAD.

Third degree of oxidation.

If a greater division in the parts of the yellow oxide of lead be facilitated, which may be done by stirring the matter, and exposing the surfaces to the renewed contact of a reverberated flame, it assumes a red colour, more or less intense, and constitutes what is called red oxide of lead, or minium. A part of this oxide is already very near to reduction; and when treated over the fire without any medium, in a very close crucible, gives a little reduced lead.

LITHARGE OF GOLD OR OF SILVER. VITREOUS OXIDE OF LEAD.

Fourth degree of oxidation.

In the last place, if massicot or minium be exposed to an accumulation of caloric, the oxide becomes in part vitrified, and forms vitreous oxide of lead, known under the name of *litharge*.

All these transitions take place accidentally in the process of cupelling, on a large scale, the principal object of which is to oxidate all the lead, in order to extract the silver it contains. The bellows, the wind of which forces the flame to reverberate on the matter in fusion, becomes the cause of the fusion and oxidation, which are the consequences of it. Yellow oxide of lead is soon formed: the current of air, which accelerates oxidation, next produces red oxide; and the latter, being in part volatilized, lines the apertures of the furnace. Vitreous oxide of lead then soon makes its appearance, under the form of scum driven forward by the current of air, which the bellows maintain on the matter. This vitreous oxide is collected through an aperture made for extracting it, and through which it is made to run under the form of stalactites.

The colour of this oxide varies. When red, it is known in commerce by the name of litharge of gold: when in this state it has suffered least from the fire. Oxide of a greenish-yellow colour is called improperly litharge of silver: it is in a state nearer to vitrification than the former. The colour, therefore, of the vitreous oxide depends on the action of the caloric, which may be stronger or weaker in the course of the operation.

Gray oxide of lead is not used in painting: it is employed only for varnishing earthen ware and common pottery.

Yellow oxide, or massicot, was employed in painting before painters were acquainted with Naples yellow and that of Montpellier, which have been substituted in its stead.

The use of red oxide, or minium, is more extensive. It is employed in house-painting, coach-painting, &c. to compose beautiful reds, and to serve as a ground to vermilion, which is applied to the painting of decorations which require durability.

Vitreous oxide of lead (litharge) is of no other use in painting than to free oils from their greasy particles, for the purpose of communicating to them a drying quality. Red litharge, however, ought to be preferred to the greenish-yellow: it is not so hard, and answers better for the purpose to which it is destined.

When painters wish to obtain a common colour of the ochrey kind, and have no boiled oil by them, they may paint with linseed oil, not freed from its greasy particles, by mixing with the colour about two or three parts of litharge, ground on a piece of porphyry with water, dried and reduced to fine powder, for sixteen parts of oil. The colour has a great deal of body, and dries as speedily as if drying oil had been used.

Lamp black. Fat soot resulting from the decomposition of resins and oils by fire.

Lamp black, as already seen in the first part of this work, is produced from the thick smoke exhaled by fat resinous bodies in a state of combustion. It is grease mixed with undecomposed resin, and is attended with the inconvenience of becoming red. It is not, therefore, employed in delicate colours. It is destined for the oil colours applied to railing, balustrades, &c.

It might be employed, however, in the more delicate kinds of painting, if washed to separate from it the foreign matters, and then reduced to the state of pure charcoal. The last quality may be communicated to it by exposing it in a close crucible to a heat capable of decomposing entirely the resinous or oily parts, which still remain united to the charred part. In this case it emits a thick smoke, which is suffered to escape through a small aperture in the cover.

It might appear, on the first view, that the same black substance might answer in all cases which require the use of this colour, whether destined for an uniform ground, or intended by its mixture with other colouring parts to form various shades. Long experience, however, has established other principles. It is known that a black substance, which produces an admirable effect in a fine composition, would produce an inferior effect in a composition of another kind. Hence the distinction established between several black colouring substances which borrow their name from the producing substance; as smoke black, black from beech wood, black of peach stones, ivory black, or black from calcined bones.

Particular kind of lamp black.

I have long employed a beautiful black, which may be easily procured. Nothing is necessary, for this purpose, but to suspend over a lamp a funnel of tin-plate, having above it a pipe to convey from the apartment the smoke which escapes from the lamp. Large mushrooms of a very black carbonaceous matter, and exceedingly light, will be formed at the summit of the cone. This carbonaceous part is carried to such a state of division as cannot be given to any other matter by grinding it on a piece of porphyry. This black goes a great way in every kind of painting. It may be rendered drier by calcination in close vessels.

I must here observe that the funnel ought to be united to the pipe, which conveys off the smoke, by means of wire, because solder would be melted by the flame of the lamp.

Beech black. Beech charcoal.

Beech, like every other kind of wood, furnishes by combustion a charcoal, which, when well ground on porphyry and mixed with white oxide of lead, gives a blueish gray colour. When applied in distemper or in oil painting it will be proper to reduce it to an impalpable powder, free from those small brilliant facets observed in charcoal badly ground. This may be easily accomplished by grinding it with water, and re-grinding it after the desiccation of the paste. This black, if the paste, after its extreme division, be besprinkled on a filter with warm water, to carry off the saline parts adhering to it, will be less apt to effloresce.

Black from wine lees.

This black results from the calcination of wine lees and tartar; and is manufactured on a large scale in some districts of Germany, in the environs of Mentz, and even in France. This operation is performed in large cylindric vessels, or in pots, having an aperture in the cover to afford a passage to the smoke, and to the acid and alkaline vapours which escape during the process. When no more smoke is observed the operation is finished. The remaining matter, which is merely a mixture of salts and a carbonaceous part very much attenuated, is then washed several times in boiling water; and it is reduced to the proper degree of fineness by grinding it on porphyry.

If this black be extracted from dry lees, it is coarser than that obtained from tartar; because the lees contain earthy matters which are confounded with the carbonaceous part.

This black goes a great way, and has a velvety appearance. It is used chiefly by copper-plate printers.

Black from burnt peach stones.

Peach stones, burnt in a close vessel, produce a charcoal, which, when ground on porphyry, is employed in painting to give an old gray.

Black from burnt vine twigs.

Vine twigs reduced to charcoal give a blueish black, which goes a great way. When mixed with white it produces a silver white, which is not produced by other blacks: it has a pretty near resemblance to the black of peach stones; but to bring this colour to the utmost degree of perfection, it must be carefully ground on porphyry.

Ivory black. Bone black.

Put into a crucible, surrounded by burning coals, fragments or turnings of ivory, or of the osseous parts of animals, and cover it closely. The ivory or bones by exposure to the heat will be reduced to charcoal. When no more smoke is seen to pass through the joining of the cover, leave the crucible over the fire for half an hour longer, or until it has completely cooled. There will then be found in it a hard carbonaceous matter, which, when pounded and ground on porphyry with water, is washed on a filter with warm water, and then dried. Before it is used it must be again subjected to the muller.

Black furnished by bones is reddish. That produced by ivory is more beautiful. It is brighter than black obtained from peach stones. When mixed in a proper dose with white oxide of lead, it forms a beautiful pearl gray. Ivory black is richer. The Cologne and Cassel black are formed from ivory.

OF OCHRES.

Of all the metals, iron is that which opposes the least resistance to the chemical action resulting from its contact with different substances, while exposed to the influence of humidity and of the air. Earths, salts, acids, sulphur, arsenic, and even water, become, under certain circumstances, the origin of modifications which transfer it from the order of simple bodies to that of compound substances. Volcanic fires and caloric, disengaged by the effect of subterranean combinations, of which itself appears to be one of the chief principles, act upon it in a manner more or less energetic, and communicate to it relative forms and properties.

Brown, yellow, and red ochres evidently exhibit the effects of a sort of combustion, or rather oxidation, more or less extensive and more or less accelerated. Water seems to be the principal promoter of this oxidation; but the latter finds there also the agent of its decomposition. The hydrogen, which is one of its constituent principles, escapes under the form of inflammable gas; while the oxygen, another principle of water, unites to the metal, and converts into an oxide.

This oxide is more or less charged with oxygen, and more or less mixed with argillaceous earth and carbonate of lime (calcareous earth).

Brown ochre.

When the oxidation of the iron is not very extensive, the result is a brown ochre. Carbonic acid often forms a part of it.

Ochre de rue.

A degree more in the progress of the natural oxidation of iron, that is to say, a quantity of oxygen somewhat greater than in brown ochre, and a mixture of clay, give ochre of a dark yellow colour. This mass constitutes *ochre de rue*, which is extracted by washing it in a large quantity of water.

Calcined ochre de rue.

This ochre de rue subjected to the action of accumulated caloric (a very active fire) acquires a yellow colour, more or less developed according to the degree of oxidation acquired by the influence of the process.

Natural yellow ochres.

In many cases nature frees the artist from the trouble of this artificial oxidation. It prepares ochres on a large scale, and very much varied in their colour. They are produced in the ci-devant Auvergne, and in all countries in the neighbourhood of volcanoes, and form articles of commerce under the names of dark yellow ochre and bright yellow ochre. These ochres are more or less argillaceous; they are often marly, that is to say, mixed with clay, carbonate of lime (calcareous earth), and coloured by iron. They are separated from the sand and stones they may contain by careful washing.

Red ochre.

When this oxidation is effected in the neighbourhood of volcanic fires, or by the effect of subterranean combinations of great extent, or under the influence of chemical processes, as in the operation for making artificial sulphates of iron (martial vitriol), in which a great deal of caloric is developed, the colour assumed by the oxide of iron is more exalted. It is a red more or less bright. This red ochre, or red oxide of iron, mixed in various proportions with clay or marl, if a natural production, will be pure red oxide of iron; and if a production of art will be English red.

Natural red ochre is very abundant in volcanic countries, as is the case in Auvergne; the different departments of which produce very beautiful kinds. Clay forms the greater part of it; and it is this substance which renders it so soft to the touch.

The method of purifying ochres is simple. Though drier than pure clays, they are lighter than sand, and the fragments of stones which may be mixed with them. They dilute readily in water, and during this washing suffer to be precipitated those bodies which are heavier than themselves. The water charged with them is decanted, by making it pass into a trough lower than the vessel in which they were washed; and when the sediment is formed, the clear water is drawn off. The coloured paste is then taken out, and being dried is divided into small masses.

When an ochre is composed of oxide of iron and clay, it resists the action of acids. If an effervescence is produced, the composition is of a marly nature. Carbonate of lime (calcareous earth) is found in these ochres in different proportions. In this case the ochre is drier. It exhibits less body than an ochre entirely argillaceous, when employed in oil or varnish painting.

It is seen by this short view of these ochres that iron, by its different degrees of oxidation, natural or artificial, becomes the base of several kinds of colour; and that it renders a very extensive service to painting. In this respect no metallic substance is equal to it.

English-red. Reddish brown and dark red oxide of iron without mixture.

Art, which operates in a direct manner on iron, and which cannot admit in its processes the slow progress of nature, communicates to it only red tints, more or less obscure, and more or less approaching to a beautiful red. Ochres are earthy oxides of iron: those made by art are pure oxides. Under the latter state they have often need of being mixed with other substances capable of modifying the hardness which these pure oxides would give to the tint, and of rendering them more agreeable to the eye.

I shall class among this last kind of oxides of iron the reddish brown, the dark red of England, and even the Prussian red, which results from the decomposition of the sulphates of iron (martial vitriol), or which are extracted from the residua of the operation by which nitrate of potash (nitre) is decomposed to convert it into nitrous acid (aquafortis). These residua are darker in colour, according as the temperature has been higher during the time of the operation.

These residua are pulverized and washed, to carry off the saline parts which are mixed with them. The paste is then carefully ground, and afterwards washed. When a sufficient interval has been left to give the coarser parts time to be precipitated, the water, which is charged with the most attenuated parts, is decanted. A sediment is then formed by rest, which after desiccation acquires a beautiful bright red colour.

The sediment deposited, during the first interval, gives an obscure red; but if the artist is desirous to lessen the quantity, in order to increase that of the bright red, it is dried, calcined a second time, and then ground. The washing is then repeated as before; and the result is a new dose of bright red and of obscure red. These different reds, prepared in this manner, are much sought after by porcelain painters, &c. But when destined for house-painting, &c. the same care is not necessary. The oxidation of the sulphates of iron is effected on a very large scale, and the colours produced are the common reds applied to the painting of various articles.

The English, who have extensive vitriol manufactories, in which they employ various processes, use for pulverizing red oxide of iron the same mechanism as for the glazing of gunpowder. It consists of a barrel suspended on two axles, and moved by a handle or by water. The dried masses of colcothar or washed red are put into this barrel, together with several bullets. By turning the barrel the bullets are made to revolve, and in a little time the dry matter is reduced to the state of powder.

The method mentioned under the article indigo may also be employed. In this case the pulverization is effected in the bason.

Prussian red.

The Prussians prepare, on a pretty extensive scale, and by means of an open fire, a kind of colcothar (red oxide of iron) which is calcined several times, and the washing of which is conducted in such a manner as to extract, by one operation, several sediments, differing in beauty according to the time employed in the precipitation. The first sediment formed in a determinate time is coarser than the second, and so on in succession. It results from this division of the time necessary for the total precipitation of the suspended parts, that the last sediment exhibits parts more attenuated. The red colour which thence results is indeed sufficiently delicate to be admitted to a place on the palette of the painter.

Litmus.

The Canary and Cape de Verd islands produce a kind of lichen or moss which yields a violet colouring part, when exposed to the contact of ammonia disengaged from urine, in a state of putrefaction, by a mixture of lime. When the usual processes are finished it is known by the name of litmus.

This article is prepared, on a large scale, at London, Paris, and Lyons. In the last-mentioned city another kind of lichen, which grows on the rocks like moss, is employed. This lichen is very abundant in the ci-devant Auvergne. The litmus resulting from it is inferior to that of the Canaries.

The ammonia (volatile alkali) disengaged by means of lime from urine in a state of putrefaction, joins the resinous part of the plant, develops its colouring part, and combines with it. In this state the lichen forms a paste of a violet-red colour, interspersed with whitish spots, which give it a marbled appearance.

Litmus is employed in dyeing, to communicate a violet colour to silk and woollen. It is used also for colouring the liquor of thermometers. The varnisher composes with it his violet and lilac varnishes; but the colour is not durable.

Orpiment. Yellow sulphurated oxide of arsenic.

Orpiment is the result of the combination of nine parts of arsenic and one of sulphur; and hence the name given to it in the New Nomenclature: *Yellow sulphurated oxide of arsenic.*

Two kinds of it are known in commerce: one composed of large brilliant laminæ of a beautiful yellow colour; the other in small facets, the yellow colour of which has a greenish tint.

Watin forbids the use of this substance, on account of its dangerous effects, and the consequences that may result to artists who are ignorant of its composition. I shall here add another consideration, which is of importance to the art of painting; namely, that every arsenical substance makes itself known by the pernicious influence it exercises on all metallic bodies near it. This remark alone is sufficient to cause it to be banished from valuable pictures, and from all painting of a delicate nature. The reader may see under the article lemon yellow, golden yellow, other reasons for proscribing the use of orpiment, and of white metallic oxides. When orpiment is slightly calcined, it forms souci yellow.

Realgar. Red sulphurated oxide of arsenic.

Realgar differs from orpiment only by the quantity of sulphur it admits into its composition, which requires four-fifths of arsenic and one-fifth of sulphur. This proportion gives to the whole a ruby colour; and hence the new name by which it has been distinguished. This colour would entitle it to a distinguished place among the substances employed in painting, were it not excluded by the same reasons as those mentioned in the article on yellow oxide of sulphurated arsenic. Realgar, as well as the preceding, is a volcanic production which art can imitate, and which is then known in commerce by the name ruby of arsenic, artificial realgar.

Anatto. Charged extract of a colouring fecula.

Anatto is a colouring fecula of a resinous nature, extracted from the seeds of a tree very common in the West Indies, and which in height never exceeds fifteen feet. It is reduced by evaporation to a sort of extract, which is spread out on boards to dry slowly. The anatto dried in this manner has a more exalted colour than that dried in the sun.

The Indians employ two processes to obtain the red fecula of these seeds. They first pound them, and mix them with a certain quantity of water, which in the course of five or six days favours the progress of their fermentation. The liquid then becomes charged with the colouring part; and the superfluous moisture is afterwards separated by slow evaporation over the fire.

The other method consists in rubbing the seeds between the hands in a vessel filled with water. The colouring part is precipitated, and forms itself into a mass like a cake of wax; but if the red fecula, thus detached, is much more beautiful than in the first process, it is less in quantity. Besides, as the splendour of it is too bright, the Indians are accustomed to weaken it by a mixture of red sandal wood.

Anatto, which is known to us only in commerce, is sold under the form of cakes, wrapped up in the leaves of the *canna Indica*. When in the state of paste, however, any form may be given to it at pleasure.

The natives of the West Indian islands used formerly to employ anatto for painting their bodies, &c.: at present it is applied, in Europe, to the purposes of dyeing. It is employed to give the first tint to woollen stuffs intended to be dyed red, blue, yellow, and green, &c.

In the art of the varnisher it forms part of the composition of changing varnishes, to give a gold colour to the metals to which these varnishes are applied.

It ought to be chosen of a flame colour, brighter in the interior part than on the outside, soft to the touch, and of a good consistence. The paste of anatto becomes hard in Europe; and it loses some of its odour, which approaches near to that of violets.

Bastard saffron. Flowers of the carthamus.

Bastard saffron is the flower of a plant known under the name of carthamus. This plant, brought originally from Egypt, has been naturalized in France, and is of great use in dyeing. It produces flowers with fibrous fleurets, above an inch in length, cut into five parts, and of a dark red saffron colour.

These flowers contain two colouring parts: one soluble in water, and which is thrown away; the other soluble in alkaline liquors. The latter colouring part becomes the basis of various beautiful shades of cherry colour, ponceau, rose colour, &c. It is employed for dyeing feathers; and it constitutes the vegetable red, or Spanish vermilion, employed by the ladies to heighten their complexion. It is used by varnishers in some of their compositions; but the colour is not durable.

Bastard saffron cannot furnish its resinous colouring part, provided with all its qualities, until it has been deprived of that which is soluble in water. For this purpose, the dried flowers of the carthamus are inclosed in a linen bag, and the bag is placed in a stream of running water. A man with wooden shoes gets upon th. bag every eight or ten hours, and treads it on the bank until the water expressed from it is colourless.

These moist flowers, after they have been strongly squeezed in the bag, are spread out on a piece of canvas extended on a frame, and placed over a wooden box; and they are covered with five or six per cent. of their weight of carbonate of soda (salt of soda). Pure water is then poured over them; and this process is repeated several times, in order that the alkali may have leisure to become charged with the colouring part, which it dissolves. The liquor, when filtered, is of a dirty red, and almost brown colour. The colouring part, thus held in solution by an alkaline liquor, cannot be employed for colouring bodies until it is free; and to set it at liberty, the soda must be brought into contact with a body which has more affinity for it than it has for the colouring part. It is on this precipitation, by an intermediate substance, that the process for making Spanish vermilion is founded, as well as all the results arising from the direct application of this colouring part in the art of dyeing.

When carthamus is employed for a saffron colour, it does not appear that any use is made of the colouring part which is insoluble in water: painters seek after that only which the dyers reject. It is not improbable that a much better effect would be produced by employing the washed carthamus alone, and forming it into a soft paste, by mixing it with the liquor containing the colouring part, which might be afterwards precipitated with a diluted acid.

Spanish vermilion.

To make this vermilion, pour into the alkaline liquor which holds in solution the colouring part of bastard saffron, such a quantity of lemon juice as may be necessary to saturate the whole alkaline salt. At the time of the precipitation, the latter appears under the form of a fecula full of threads, which soon falls to the bottom of the vessel. Mix this feculent part with white talc (chalk of Briançon) reduced to fine powder, and moistened with a little lemon juice and water. Then form the whole into a paste; and having put it in small pots, expose it to dry. This colour, called Spanish vermilion, is reserved for the use of the toilet; but it has not the durability of that prepared from cochineal.

When this colouring matter is destined for house-painting, &c. as for the red inclining to yellow applied to different articles, the liquor charged with the colouring part, precipitated by acid of lemon juice, is formed into a paste with white argillaceous or marly earth, which is divided into small cakes, and then dried.

Red sandal wood.

Red sandal wood is a solid, compact, heavy wood, with fibres sometimes straight and sometimes twisted, and of an astringent savour. Its colour is a brownish red. This wood is obtained from a large tree which is very abundant on the coast of Coromandel in the East Indies.

It produces a dark red colour, which is employed in dyeing, and communicates its colouring part to water and to alcohol (spirit of wine), but not to oils. In consequence of this property it may be employed in the coloration of changing varnishes.

The voluminous work entitled *Secrets des Arts et Metiers* says, that an extract of it obtained by a decoction in water is capable of colouring essential oils. The author of that work never certainly tried the experiment: but it communicates to alcohol a very bright colour.

Dutch pinks.

Dutch pinks are much used in house-painting, &c. and in painting in distemper and in oil. They are seldom employed by artists who paint pictures, because they prefer yellows obtained from metallic substances, as being more durable.

The Dutch pinks are composed of earthy parts charged with the colouring matter or colouring fecula of certain plants. The basis of that of the first quality is clay. Sometimes this base is marly (a mixture of clay and chalk). and in certain cases it is carbonate of lime (chalk). The last-mentioned composition of Dutch pinks is inferior to the other two. It is much better suited to painting in distemper than to oil painting.

Dutch pink from woad.

Woad is a plant common in France and in Spain. When cultivated it is superior for dyeing to the uncultivated kind. The use of its colouring part is not confined to dyeing; it is extended also to painting, under the denomination of Dutch pink.

To make Dutch pink, boil the stems of woad in alum water, and then mix the liquor with clay, marl, or chalk, which will become charged with the colour of the decoction. When the earthy matter has acquired consistence by evaporation, form it into small cakes, and expose them to dry. It is under this form that the Dutch pinks are sold in the colour shops.

Another kind of Dutch pink.

This kind of Dutch pink is made with an aluminous decoction of woad mixed with chalk, which becomes charged with the colouring part of the plant. The use of chalk renders this kind of pink inferior to all those the base of which is of an argillaceous earth, or a very argillaceous marl. These compositions would, perhaps, acquire some additional qualities were the clay, marl, or chalk mixed with a second, and even a third decoction of the plant.

Dutch pink from yellow berries.

The small buckthorn produces a fruit, which when collected green are called *graine d'Avignon*, or yellow berries. They have been distinguished by the name of *graine d'Avignon*, because the plant which furnishes them grows in great abundance in the neighbourhood of that city.

These seeds, when boiled in alum water, form a Dutch pink superior to the former. A certain quantity of clay or marl is mixed with the decoction, by which means the colouring part of the berries unites with the earthy matter, and communicates to it a beautiful yellow colour.

These yellow berries are much used in dyeing, and even in cotton printing, which occasions a great consumption of yellows.

The colouring part of Dutch pinks is darker according as the earthy substance employed is less mixed with carbonate of lime (calcareous earth or chalk). Clay contributes to the durability of the colour. In consequence of this principle, a Dutch pink resulting from the decomposition of sulphate of alumine might be substituted for the mixtures here described.

Brownish yellow Dutch pink by the decomposition of sulphate of alumine (alum).

Boil for about an hour in twelve pounds of water a pound of yellow berries, half a pound of the shavings of the wood of the barberry shrub, and a pound of wood ashes. Then strain the decoction through a piece of linen cloth.

Pour into this mixture warm, and at different times, a solution of two pounds of the sulphate of alumine (alum) in five pounds of water: a slight effervescence will take place; and the sulphate being decomposed, the alumine, which is precipitated, will seize on the colouring part. The liquor must then be filtered through a piece of close linen, and the paste which remains on the cloth, when divided into square pieces, is exposed on boards to dry. This is brown Dutch pink, because the clay in it is pure. The intensity of the colour shows the quality of this pink, which is superior to that of the other compositions.

Dutch pink with Spanish white, or with ceruse, preferable for oil painting.

By substituting for clay a substance which presents a mixture of that earth and metallic oxide, the result will be Dutch pink, superior, no doubt, to any of those the composition of which has been already given.

The ceruse is ground on porphyry with water, and is then separated from the porphyry with a wooden spatula. In this state it is fit for use; but it will be proper to let it lose its humidity.

Boil separately a pound of yellow berries and three ounces of the sulphate of alumine (alum) in twelve pounds of water, which must be reduced to four pounds. Strain the decoction through a piece of linen, and squeeze it strongly. Then mix up with it two pounds of ceruse and a pound of pulverized Spanish white. Evaporate the mixture till the mass acquire the consistence of a paste; and having formed it it into small cakes, dry them in the shade.

When these cakes are dry, reduce them to powder, and mix them with a new decoction of yellow berries. By repeating this process a third time, you will obtain a Dutch pink so much charged with colouring matter that it will be brown.

In general, the decoctions must be warm when they are mixed with the earth. They ought not to be long kept, as their colour is speedily altered by the fermentation. Care must be taken also to use a wooden spatula for stirring the mixture.

Dutch pinks are employed in distemper and in oil. They are however said, and with some foundation, not to be durable. The colouring part in them is the less fixed as the earthy substance combined with it contains less chalk. Those, therefore, who wish to select the best, must prefer those which produce the least effervescence with acids. In this point of view I have examined several of the English pinks, which occasioned very little effervescence.

When only one decoction of woad or of yellow berries is employed to colour a given quantity of earth, the Dutch pink resulting from it is of a bright-yellow colour, and is easily mixed for use. When the colouring part of several decoctions is absorbed, the composition becomes brown, and is mixed with more difficulty, especially if the paste be argillaceous; for it is the property of this earth to unite with oily and resinous parts, to adhere strongly to them, and to incorporate with them. In the latter case, the artist must not be satisfied with mixing the colour: it ought to be ground; an operation which is equally proper for every kind of Dutch pink, and even the softest, when destined for oil painting.

Umber earth.

Umber earth is a kind of clay mixed with a little oxide of iron, which renders it dry, and is rather a bituminous earth slightly ferruginous than a brown ochre. It is brought from Nocera in Umbria, a district of Italy, whence it derives its name. Sometimes it is called brown ochre.

Umber earth is very much employed in painting for browns. When slightly calcined it acquires a browner tone, and produces the colours of woad. If it be inclosed in an iron box before it is subjected to the fire, the colour will be mellower.

The bishopric of Cologne produces a kind of umber earth which is heavier, as well as browner, and which has a stronger and more disagreeable smell than that of Nocera. It is also more bituminous and more charged with iron: in a word, it is inferior to it in quality.

In general, deposits formed by marshy plants, those of morasses, which contain vegetables in part destroyed and in part impregnated with bitumen, almost always present a variety of umber earth, which might be employed, with success, for dark grounds. For delicate works, however, such matters ought to be selected as are least susceptible of alteration from time, and from the contact of the oily bodies employed in painting. The earth of Nocera is light, subtle, argillaceous, and inflammable; and it emits a fetid odour of coals when exposed to a strong heat. Its qualities, established by long experience, have insured it a preference from painters.

Green earth of Saxony.

Nature often prepares colours to which art can make no addition, when artists know how to limit the use of them. Of this kind is the green earth of Saxony. Hungary, Saxony, and Italy, which contain abundance of copper mines, furnish green earths, which are applied to particular objects, because the colouring principle, which is the same in them all, is not contained in them all in the same proportions.

These coloured earths are of an argillaceous nature. They arise from the oxidation of copper by water, or rather from the decomposition of the sulphates of copper (cupreous pyrites) which are there abundant, and which are conveyed by the water into banks of marl, where the acid exchanges its metallic base. The intensity of the colour depends on the quantity of the metallic oxide it contains. The earth of Kernhausen, in Hungary, is of this kind. When earths are thus charged with colouring matter they may be employed in distemper, without any modification; but they are not fit for oil painting until they have been corrected. The colour would otherwise become a dark and obscure green: in this case the colour requires to be mixed with one part or a part and a half of ceruse. Green earth of Saxony requires also, for this kind of painting, a correction nearly similar.

Green earth of Verona.

Green earth of Verona is dry, of a light green colour, and when mixed with oil has not the same fault as the green earth of Kernhausen, in Hungary, and that of Saxony. It is equally proper for distemper and for oil painting.

These two kinds of earth are real cupreous oxides, which contain a little carbonic acid (fixed air).

Terra merita.

Terra merita is the root of a plant of the family of the *canna Indica*, which grows in great abundance in every part of India, and which is carefully cultivated by the Indians.

This slightly aromatic root is oblong and bent, with knots at certain distances. It is heavy and compact; of the size of the little finger; pale on the outside, and yellow and even red in the inside when it is old. The roots of the small species are round; and when broken exhibit concentric circles of a red colour.

This red is very much used in dyeing. It is, however, found in general that it is inferior to woad, both in regard to duration and to colour; but dyers prefer it in the use which they make of yellow, in dyeing scarlet, to heighten the colour of the cochineal or kermes, of which they compose the dyeing liquor.

Terra merita is employed in varnishing only under the form of a tincture. It enters into the mixture of those colouring parts which contribute the most to give to metals the colour of gold. It ought to be chosen sound and compact.

Verdigris. Green oxide of copper by vinegar.

Copper, when exposed to the air, becomes covered with a kind of green rust, known under the name of green oxide of copper. Verdigris is an artificial production, arising from copper converted into oxide by means of vinegar. This substance, the consumption of which is very extensive, forms a valuable branch of commerce. The whole almost of what is consumed in Europe is manufactured at Montpellier, and in the environs of that city. An attempt has been made to establish a manufactory of the same kind at Grenoble; but whether less care be taken there than at Montpellier, to guard against adulteration, or whether the nature of the wines of that country is not so proper for that use as the wines of Languedoc, the verdigris of Montpellier has always retained a superiority in the market.

Most families in the latter city are employed in manufacturing verdigris. The wines in that part of the country being high coloured, spirituous, and charged with acid, facilitate the process for preparing it. Montet, a chemist of Montpellier, gave a very correct detail of the operation in the Memoirs of the Academy of Sciences for 1750 and 1753, of which the following is an extract:

" Large earthen jars are filled with grapes, from which the stones have been extracted, and which have been previously dried in the sun. They are then left immersed for eight or ten days in wine, which has already been employed for the preparation of verdigris, and which has passed to the state of acid fermentation. This wine is drawn off, and the grapes being slightly squeezed, alternate strata of grapes and thin plates of copper are placed in the same jar, beginning and ending with a stratum of grapes. The vessels are then covered, and left in that state for five or six days.

" When it is observed that the first plates have acquired a green colour, with white spots, they are taken out; and a certain number of them are arranged, one above the other, in a cellar, which ought neither to be too dry nor too damp, where they are left to dry.

" They are then moistened on the sides with the same kind of wine, or with water; and this operation is repeated two or three times. In the mean while the metallic matter, penetrated by the wine, swells and forms a sort of green crust, which is carefully scraped off. In this manner the whole plate of copper is converted into a kind of rust, which is afterwards put into bags of sheeps' leather, and exposed to the air to dry. It is under this form that it is sold in the shops. The oxide, which after this operation may be considered as copper penetrated by the acid of the vinegar, does not however possess any saline properties. It is an oxide of copper, which contains more carbonic acid (oxygen united to carbon) than vinegar: it holds a mean rank between the oxide and the saline state.

"It ought to be chosen dry; of a beautiful colour, and as free from spots as possible.

"Verdigris is much employed in oil painting and in distemper, as well as for colouring prints and drawings; but it requires more care in the application than any other colour, whether used alone, which is rare, or employed in compositions. It may be considered as one of the first ingredients in mixtures; but delicate painting would not find in verdigris all the purity it requires; and therefore, when used for that purpose, it is subjected to a kind of purification which gives it a saline character, and at the same time deprives it of all those impurities which are found in common verdigris."

PURIFICATION OF VERDIGRIS.

Calcined verdigris. Distilled verdigris. Crystallized verdigris. Acetite of copper.

Purification disengages from the oxide of copper those matters which are foreign to it. There are indeed observed in it fragments of the grapes, and small laminæ of corroded copper, which have escaped oxidation. All these impurities are separated from it by uniting it with a new quantity of the acid of vinegar; and by this addition the cupreous oxide acquires the saline properties: namely, those of dissolving in water and of crystallizing.

The industry of the Dutch has engrossed this branch of manufacture, the crude materials of which are in the hands of the French.

One part of pounded verdigris, and from six to eight or more parts of vinegar, according to its strength, are boiled in large copper kettles. The ebullition is continued an hour, during which time the matter is stirred with a rake. When the oxide is completely dissolved, the kettles are taken from the fire, and the liquor is suffered to remain at rest till it becomes clear. Osier twigs about a foot long, and split into four parts throughout almost their whole length, are immersed in the liquor, the four parts being separated by wooden wedges, which leave an interval of about two inches between them at the extremity: these pyramids are suspended by packthread, and left in the liquor till they become covered with crystals.

They are then taken out, and the saline liquor is evaporated till it form a pellicle. It is then left to cool, and the pyramidal sticks are again immersed in it, till they become charged with a new quantity of crystals. This operation is continued until the intervals between the parts of each stick are entirely filled with crystals, so as to represent a solid pyramid, the weight of which is about three or four pounds. The crystals are of a rhomboidal form; and when new are transparent, and have a beautiful green colour. At the end of some time they effloresce, that is to say, become white, and lose their transparency by the effect of insensible evaporation. These crystals form *acetite of copper*, and are known to artists by the name of *distilled verdigris*, *crystallized verdigris*, *calcined verdigris**.

Acetite of copper, when new, is of a beautiful transparent green colour: when old and pulverulent it exhibits a dull green. In the latter state it is more proper for being ground with boiled oil. In general all colours of a saline nature, destined to be ground with oil, must be deprived of their water of crystallization; and this can be accomplished only by reducing them to powder, and exposing them to the sun, or in a stove, before they are mixed with the oil.

Colours prepared with acetite of copper (crystallized verdigris) are much brighter than those composed with verdigris. But the high price of this colour prevents it from being employed in all cases. It is therefore reserved for painting of the noblest kind, and for that

* Artists have given to certain matters employed in the arts, denominations which are more calculated to embarrass than to encourage amateurs. I myself have often been confounded by the word *calcined*, which is applied to several substances as an epithet. This expression is often employed in regard to orpiments (yellow sulphurated oxide of arsenic). If this substance were treated over an open fire, it would be dissipated; and in close vessels it would assume a rose or red colour, and form ruby of arsenic.

The case is the same with acetite of copper, which is sometimes called *calcined verdigris*. Calcination would revive the copper: the same denomination has been applied to sulphate of zinc.

This is a real abuse of words, which habit preserves among our workmen, and which ought to be banished if we are desirous of rendering the language of the arts intelligible.

applied by the varnisher to certain delicate articles, such as works of papier maché, metals, &c.

Those who paint pictures are accustomed to grind this colour with oil of pinks, and to put it into small bladders, which they prick in order to extract by pressure the quantity they are desirous of using. This colour extends exceedingly well. It possesses transparency, and is employed with success for glazing certain argentine parts to represent sheets of water. When applied to metal, the reflection of the light produces a very fine effect, which is still heightened by the colour. This colour, when mixed with copal varnish and applied to foil, produces a very rich effect.

Liquid verdigris for colouring maps, &c.

Put an ounce of pulverized verdigris into the bottom of a matrass, with eight or ten ounces of good distilled vinegar. Place the matrass on a warm sand bath, and shake it from time to time, till the liquid has acquired a beautiful dark green colour inclining to blue. Leave the mixture at rest, that it may become clear, and pour it into a clean vessel, which must be closely shut. This preparation is used for colouring maps and prints. The colour may be lowered, if necessary, by adding a little water or distilled vinegar in the shell into which the brush is dipped.

Sap green.

Sap green is the feculent part of the fruit of the buckthorn. The berries, when black and very ripe, are bruised, and subjected to a press, in order to extract the juice. This juice is mixed with a little sulphate of alumine (alum), dissolved in a sufficient quantity of water, and the whole is evaporated over a slow fire till it is brought to the consistence of honey. The extract is then put into a swine's bladder, and hung up in the chimney to dry.

When this extract is to be used, dilute it with a little water, to which it will communicate a very beautiful green colour. This colour is used only by fan-painters, draftsmen who draw plans, and for other works of the same kind.

It ought to be chosen compact, heavy, and of a beautiful green colour.

CHAPTER II.

Philosophical account of the origin of colours, applied to material colours, simple and compound; with a description of the processes which art employs to vary the number and richness of the tints resulting from the mixture of them.

One of the most interesting phænomena in nature ever subjected to philosophical research, is that which accompanies the emission of the solar light. Mankind were far from imagining that this subtile fluid, this agent of the numerous phænomena which constitute the life of nature, this generator of the varied colours which ornament the organized bodies that cover the earth and people the seas, belonged to the order of compound substances. The decomposition of it, discovered by the immortal Newton, and traced out in all its details by those astonishing experiments which compose his optics, soon became the basis of the theory which that learned author has established in regard to the nature of light, and to the origin of the colours that strike our organs of vision.

Isaac Vossius, who lived before Newton, had entertained an idea, and even asserted, that the colours which tinge those objects that present themselves to our eyes existed in the solar rays. But this theory, supported by no kind of experiment capable of serving as an authority, was classed among the number of those ingenious hypotheses which occupied the philosophers of his time. The idea of Vossius was however realized by the experiments which the immortal Newton made with the prism.

This philosopher indeed proved that the rays of light, which he subjected to experiments both by analysis and synthesis, were composed of seven primitive rays, each different from the other, not only by the variety of their colour but also by their different refrangibility.

From this decomposition of light he proved that these coloured rays, when separated from each other, and in some measure insulated, excite in us the sensation of a fixed and primitive colour. The following is the order observed in the decomposition of a ray of light received on the refracting surface of a prism commencing at the lowest: red, orange, yellow, green, blue, purple, and violet.

The facility of separating colours, in analysing a bundle of rays, is the effect of the different refrangibility of each of these rays. Newton has proved also that the degree of the reflection of each coloured ray is proportioned to that of its refraction.

The theory of colours was the necessary consequence of these experiments; the aggregate of which composes the system of optics, that master piece of the human genius. It indeed follows from it,

1st. That a ray of light is composed of all the primitive colours, pure and unalterable, and therefore free from every secondary mixture that might weaken its essence.

2d. That every colour is produced merely by the decomposition of a ray of light.

This phænomenon depends on the essential composition of the bodies which concur to produce it; on the peculiar configuration of their surfaces, on their degree of density, and on their interior disposition, which renders them capable of absorbing a certain portion of the ray of light, and of transmitting another to our senses. The coloured body appears then under the simple colour of the ray which is reflected.

In some bodies the difference in the texture of their surface, in the nature of the laminæ of which they are composed, as well as in their thickness, produces phænomena of refraction and reflection more varied, which concur to promote the union of several primitive coloured rays, and consequently to produce the appearance of secondary or compound colours: changing material colours arise from this cause.

Intermediate colours might easily be made in the series of those given by the prism; but one remarkable effect is, that the less compound a colour is, it is so much the brighter and more perfect. By rendering it gradually more complex, it is at length destroyed, the ray of light being restored, such as it was before its decomposition.

According to the theory of optics, white, which results from the union of all the primitive coloured rays, and which constitutes a ray of light; black, which absorbs them entirely, and which is only the effect of that absorption, are not colours. The theory of material colours seems to contradict these ingenious results, which arise from a philosophical examination of the nature of light. White and black exist in substance. They seem even to concur towards increasing the number of the primitive colours, in the order of material bodies. They become, at least in the hands of the artist, new means and new agents to modify the tones of the positive colours of an earthy or metallic nature.

The philosophy of the heavens seems to be richer in colours than that of the earth. The former admits of seven primitive colours; and four only are found in the latter, if we suppress white and black. Of this kind are yellows, reds, and greens, to which I shall add the blue of ultramarine. Indigo blue, violet, and orange, are the secondary results of certain mixtures, by which art, the imitator of nature, has found means to approach those tones that belong to the seven primitive colours.

By admitting white and black, which are employed on the palette of the painter, we shall have six colouring substances, with which all the different tints of nature may be imitated. It is by the help of simple or compound mixtures, that art is able to display the magic of illusion in fine paintings.

A knowledge of mixtures is not the least part of the art of painting. It is by means of these mixtures that the art has been enriched by establishing another order of colours; that is to say, the factitious, secondary, or intermediate colours. It will be here proper to give a general view of the effect of these mixtures, and of the peculiar attributes of the primitive material colours. It will consist of a certain number of precepts, which are generally considered as inseparable from the art.

Black increases the obscurity of all colours, and even effaces them, if the quantity be considerable and predominant.

White renders yellows, reds, and blues, lighter. The strength of the tints depends on the respective quantities of the two substances mixed. When mixed with blue, the result is a tint more or less light, which represents the azure colour of a beautiful ſky.

White, judiciously mixed with yellows and reds, produces a tint which approaches to flesh colour. If a little ceruse be ground with very clear gum water, by adding a small quantity of liquid red, and a little lemon yellow, you will obtain tints of flesh colour which maybe varied *ad infinitum*. With reddish brown, the result will be beautiful crimson; with red, a beautiful carmine colour.

White, mixed with a little black, produces a gray more or less dark: with blue and a small quantity of black it gives a beautiful pearl gray.

Yellow and blue give rise to several kinds of green, the brightness and splendour of which depend on the manner in which they are combined: with thin liquid blue, you will obtain an exceedingly rich colour for miniature painting.

Golden yellow and violet compose admirable liquid earth colours for miniature painting.

A yellow colour may, in like manner, be obtained with an orange colour and yellowish green.

Red or vermilion loses some of its splendour and hardness when the lights are brightened with white or with Naples yellow.

Reddish brown and lemon yellow, mixed with gum water, give an aurora colour. By adding thin liquid blue you will obtain a brown wood colour, which is a valuable discovery for miniature painting.

Liquid red, mixed with violet, exhibits a rich purple: a greater or less quantity of either of these substances gives a crimson, more or less red.

Liquid red, with meadow green, gives a wood colour, which is employed in miniature painting to represent terraces and the trunks of trees *.

Painters mix carminated lakes with cinnabar or vermilion to produce the beautiful effect of bright red, destined to represent certain red parts, such as the mouth, the apertures of the nostrils, &c.

All arts admit of general principles, which have been established by long experience. If those, a sketch of which has here been given, are acknowledged by the great painters; if they follow them in the execution of their master-pieces, they ought not to remain unknown to artists, who devote themselves to house-painting, &c. nor to amateurs who are desirous of being initiated in every branch of this art.

In general, great colorists devote their whole attention to manage the white in shades, in order that they may avoid mealy and opake tones. A mixture of oxide of lead and antimony, known under the name of Naples yellow, is a great assistance to them. It sup-

* When mention is made of a liquid colour, or of its mixture with gum water, the case is applicable to miniature painting. The other combinations of colours relate to the other kinds of painting, and particularly oil painting.

plies the place of white in all cases when it is necessary to brighten the half tints, or to give reflection without experiencing all its inconveniences. With yellow also bright grays may be produced in the shades, by mixing it with different blacks, and even with ultramarine, when the composition is required to be rich and highly finished.

Artists often agree in admitting denominations which express the state or extent of the composition of a substance. Thus painters have given the name of *virgin tints* to those which are composed of only two substances, such as white and blue, white and red, white and yellow, white and lake, and so of the other simple combinations which would result from the mixture of other colours without the white: such, for example, as the green produced by Naples yellow and prussiate of iron (Prussian blue); the orange colour which results from a mixture of Naples yellow and red oxide of lead (minium); the violet produced by a mixture of red sulphurated oxide of mercury (cinnabar) and prussiate of iron. These virgin tints form second local colours, which some painters introduce on their palette, like secondary colours, which are not simple shades of a coloured body, but the mixture of two or more primitive colours.

All simple or compound colours, and all the shades of colour which nature or art can produce, and which might be thought proper for the different kinds of painting, would form a very extensive catalogue, were we to take into consideration only certain external characters or the intensity of their tint. But art, founded on the experience of several centuries, has prescribed bounds to the consumption of colouring substances, and to the application of them to particular purposes. To cause a substance to be admitted into the class of colouring bodies employed by painters, it is not sufficient for it to contain a colour: to brightness and splendour it must unite also durability in the tint or colour which it communicates. Thus every earthy, vegetable, or animal matter, of a tint more or less developed, cannot always be considered as a colouring matter necessary to painting. It cannot assume a place on the painter's palette, or in the pot of the varnisher, until experience has determined in regard to its essential qualities.

But though a coloured substance may seem improper for the usual purposes of the different kinds of painting, it does not thence follow that it ought to be rejected entirely. Colours, the employment of which cannot be generalized without inconvenience, are applied every day to particular uses in distemper and in the art varnishing. Such, for example, are certain colours extracted from vegetables, which compose the light and dark Dutch pinks; and which painters, jealous of the duration of the tints they employ, banish, and very justly, from their grand compositions. Such, also, are other substances furnished by the mineral kingdom, yellow and red sulphurated oxides of arsenic (orpiment and realgar), which refuse to harmonize with the colours most in use, and which at length develop qualities the more destructive, as they extend even to all metallic colours in contact with them, or which are near them. This destructive effect arises from the arsenic which forms a part of them*.

* That piece of board distinguished by the name of the painter's palette is a real repository of the primitive colours, arranged in a line. Another line, parallel to the former, is destined for the compound or secondary colours. The simple colours are white, Naples yellow, *ochre de rue*, Sienna earth, still more beautiful than *ochre de rue*, red or burnt ochre, red earth or burnt *ochre de rue*, vermilion, lake, prussiate of iron (Prussian blue), Saxon blue, ultramarine, black from burnt vine twigs, ivory black, &c. All these colours are ground in oil of pinks, and have the necessary consistence.

Sometimes, when colours are applied to strata of paint, or to sketches too recent, the paint sinks, and assumes a gray appearance, which conceals the real colour of the tints. White of egg, beat up with some drops of alcohol (spirit of wine), and then applied with a clean dry sponge, will restore their former lustre; but in all cases, without excepting those even which require celerity of execution, the painter who is desirous to ensure the durability of his work will take care not to apply varnish until the colours have become thoroughly dry, under the white of egg, which will not be the case till the end of a year. After this interval, the same sponge which served to apply the white of egg, if dipped in a little water, will remove it, under the form of a yellowish froth. As long as gentle friction with the sponge produces froth there is reason to conclude that the white of egg is not entirely removed.

This intermediate application of white of egg, between the period when valuable paintings are finished and that when they are varnished, is attended with two advantages, as it defends the colours from the prejudicial impression of the air, and frees them from a yellowish tint which arises from the oil, or perhaps from the colours themselves. If these conditions be strictly observed, the colours will appear under the varnish in all the beauty and richness of their tints. Some of the English painters, too anxious to receive the fruits of their composition, neglect these precautions.

But the coloured bodies which artists who paint pictures proscribe, find a very extensive employment in the hands of the house-painter. The changes which may take place in the tone of uniform colours do not produce so important effects as in a painting, where the least change in the tints destroys the harmony, contradicts the rules of perspective, and substitutes for the real tones of nature degraded tones which are absolutely foreign to it.

In the application of the colours which house-painters, &c. destine for varnish, the transition of one tint into another, more or less dark, is insensible, because it is general. Nothing offends the eye, which becomes accustomed to that transition, which may even deviate from the first tone; and if the effect no longer appears to be the same, when remembrance recalls the first moment when the painting possessed all its freshness, it however exhibits nothing disgusting.

Several artists even paint in varnish, and apply it with the colours. This precipitate method gives brilliancy to their compositions at the very moment of their being finished; but their lustre is temporary, and of short duration. It renders it impossible for them to clean their paintings; which are besides liable to crack and to lose their colour. In a word, it is not uncommon to see an artist survive his works, and to have nothing to expect from posterity.

Nothing that relates to the house-painter is foreign to the artist of a higher order, who paints compositions: in like manner, the precepts admitted by the celebrated painters deserve the attention of the varnisher, to whom the painter entrusts his greatest interests.

The observations contained in this note are the brief result of some instructive conversations I had with Saintours, a celebrated painter, my friend and relation.

This consideration is sufficient to authorize the use of colouring substances, more common, and consequently less expensive, in cases when the artist has to supply an extensive consumption.

Having said enough in these preliminary observations respecting the nature of colouring parts, and the theory of the effects of their mixture, we shall proceed to the different compositions which the varnisher employs.

COMPOSITION OF COLOURS.

Black.

Usage requires attention in the choice of the matters destined for black. The bodies which produce it do not all give the same tone. According to the catalogue of colouring bodies, several of them furnish black. The carbonaceous parts of peach stones, of the beech tree, of ivory, of vine twigs, lamp black, &c. all concur towards this object, but in a different manner. The following are their properties:

Black from peach stones is dull.

Ivory black is strong and beautiful, when it has been well attenuated under the muller.

Black from the charcoal of beech wood, ground on porphyry, has a blueish tone.

Black composed of lamp black is of a minime colour. It may be rendered mellower by making it with black which has been kept for an hour in a state of redness in a close crucible. It then loses the fat matter which accompanies this kind of soot.

Black furnished by the charcoal of vine twigs, ground on porphyry, is weaker, and of a dirty gray colour, when coarse and alone; but it becomes blacker the more the charcoal has been divided. It then forms a black very much sought after, and which goes a great way.

Painters, for the most part, confine the use of blacks to that made from burnt vine twigs or peach stones, to black of Cassel or Cologne, and even to that of asphaltum, the vigorous and transparent tones of which exhibit qualities not possessed by the rest.

The consumption of lamp black is more extensive in common painting. It serves to modify the brightness of the tones of the other colours, or to facilitate the composition of secondary colours. The oil paint applied to iron grates and railing, and the paint applied to paper snuff boxes, to those made of tin plate, and to other articles with dark grounds, consume a very large quantity of this black. Great solidity may be given to works of this kind by covering them with several coatings of the golden varnish of the fifth genus, No. 28., which has been mixed with lamp black washed in water, to separate the foreign bodies introduced into it by the negligence of the workmen who prepare it.

After the varnish is applied the articles are dried in a stove, by exposing them to a heat somewhat greater than that employed for articles of paper. Naples yellow, which enters into the composition of black varnish, is the basis of the dark brown observed on tobacco boxes of plate iron, because this colour changes to brown when dried with the varnish.

White.

White, when employed without any mixture, is in general very dull. Those who paint decorations are accustomed to heighten it with a small quantity of blue, which renders it brighter. All whites, or all white matters, are not equally proper for painting in varnish or in oil. Chalk is fit only for distemper, because the two other kinds of painting give it a brown tint.

For a distemper white, then, take Bougival white, a kind of marl or chalky clay, and having ground it with water, mix it with size. It may be brightened by a small quantity of indigo or charcoal black, ground exceedingly fine.

The white destined for varnish or for oil requires a metallic oxide, which gives more body to the colour. Take ceruse, therefore, reduced to powder*, and grind it with oil of pinks and a quarter of an ounce of sul-

* The amateur is not always furnished with instruments like the professed painter. Ceruse may be pulverized by the colourman; but it is not always free from mixture. There is one simple method, however, by which this substance may be reduced to powder, without a mortar, and without much trouble.

Place on a large sheet of paper a hair sieve, and move a cake of ceruse over it in a circular direction, pressing it a little against the hair-cloth. The friction of the latter will detach from it a fine powder, which may be collected on the sheet of paper. Should the dust fly upwards and prove incommodious, which is the case when the ceruse is very dry, the operation may be performed in a current of air. The ceruse, when thus divided, may be easily ground on a piece of porphyry.

A sieve made with metallic cloth of fine brass wire will answer better for this purpose than a hair sieve: it is much more durable.

phate of zinc (white vitriol) for each pound of oil. Apply the second coating without the addition of the sulphate of zinc, and suffer it to dry. Cover the whole with a stratum of the varnish No. 3. This colour is durable, brilliant, and agreeable to the eye.

Boiled linseed oil might be employed in the room of oil of pinks; but the colour of it would in some degree injure the purity of the white. Painters are accustomed to place on the porphyry slab, along with the colour, a spoonful of unprepared oil of pinks or nut oil, to facilitate the extension of the matter, and to retard the evaporation and desiccation of the boiled oil. The dose of this oil cannot be determined; because it ought to be proportioned to the quantity of colour employed. My method allots a common spoonful for eight or nine ounces of matter, to be ground.

White is prepared also with pure white oxide of lead, ground with a little essence, added to oil of pinks, and mixed with the varnish No. 14. The colour may be mixed also with essence diluted with oil, and without varnish, which is reserved for the two last coatings. If a dull white be not required, the colour is heightened with a little prussiate of iron (Prussian blue), or with a little indigo, which is here preferable, or with a little prepared black. The latter gives it a gray cast. But pure white lead, the price of which is much higher than ceruse, is reserved for valuable articles. In this particular case, if a very fine durable white be required, grind it with a little essence, and mix it with the varnish No. 3.

OF COMPOUND COLOURS IN WHICH CERUSE PREDOMINATES.

Light gray.

Ceruse ground with a little nut oil or oil of pinks, and mixed with a small quantity of lamp black, composes a gray more or less charged, according to the quantity of black. With this matter, therefore, mixed with black in different doses, a great variety of shades may be formed, from the lightest to the darkest gray.

If this colour be destined for distemper, it is mixed with water. If intended for oil painting, it is ground with nut oil or oil of pinks; and with essence added to oil if designed for varnish. This colour is durable and very pure if mixed with the varnish No. 12.: the varnish No. 14. renders it so solid that it can bear to be struck with a hammer, if after the first stratum it has been applied with varnish, and without size.

These light gray grounds are much sought after for apartments, especially when exposed by their situation to the strong light of the sun. The varnishes which I have here pointed out for this purpose are stronger than those made with alcohol. They are attended with the inconvenience of emitting some smell for a few months; but this may be easily prevented by glazing with an alcoholic or colourless varnish. When applied alone, and without colour, the glazing is brighter, and the colour of the ground appears with more lustre, but it is easily scratched. For the last coating the varnishes Nos. 3. and 4. are proper; and for the darkest gray No. 6.

Pearl gray.

If a particle of blue be substituted for the black in the preceding composition, or if this blue be combined with a slight portion of black, you will obtain silver or pearl gray; but that the ground may not be altered by a foreign tint, the colour for the first coating must be ground with essence mixed with a little oil of pinks: for the succeeding strata, grind with the varnish No. 12. softened with a little oil of pinks, and mix the colour with the same varnish. The pearl gray will be still brighter, if the last stratum be glazed with the alcoholic varnish No. 3. mixed with a little colour.

Flaxen gray.

Ceruse still predominates in this colour, which is treated as the other grays, but with this difference, that it admits a mixture of lake instead of black. Take the quantity, therefore, of ceruse which you may think necessary to employ, and grind it separately. Then mix it up, and add the lake and prussiate of iron (Prussian blue) also ground separately. The quantities of the last two colours ought to be proportioned to the tone of colour required to be given to the article painted.

This colour is proper for distemper, for varnish and oil painting. For varnish, grind it with the varnish No. 13., to which a little oil of pinks has been added, and then mix it up with the varnish No. 14. For oil painting, grind with unprepared oil of pinks, and mix up with resinous drying nut oil*. The painting is brilliant and solid.

* See Part I. p. 101.

When the artist piques himself on care in the preparation of those colours which have splendour, it will be proper, before he commences his labour, to stop up the holes formed by the heads of the nails in wainscoting with a cement made of ceruse or with putty.

The first stratum of colour, taking flaxen gray for an example, is ceruse without any mixture, ground with essence added to a little oil of pinks, and mixed up with essence. If any of the traces of this first stratum are uneven, it will be proper to rub it lightly when dry with pumice stone. This operation, which seems so remote from finishing, contributes greatly to the beauty and elegance of the polish when the varnish is applied.

The second stratum is composed of ceruse, changed to flaxen gray by the mixture of a little Cologne earth, as much English red or lake, and a particle of Prussian blue. First make the mixture with a small quantity of ceruse, in such a manner that the result shall be a smoky gray, by the addition of the Cologne earth. The red which is added makes it incline to flesh colour, and the Prussian blue destroys the latter to form a dark flaxen gray. The addition of ceruse brightens the tone. This stratum and the next are ground, and mixed up with varnish as before.

This mixture of colours, which produces flaxen gray, has the advantage over pearl gray, as it defends the ceruse from the impression of the air and of the light, which makes it assume a yellowish tint. Flaxen gray composed in this manner is unalterable. Besides, the essence which forms the vehicle of the first stratum contributes to call forth a colour, the tone of which decreases a little by the effect of drying. This observation ought to serve as a guide to the artist, in regard to the tint, which is always stronger in a liquid mixture than when the matter composing it is extended in a thin stratum, or when it is dry.

I must here observe, that every kind of sizing, which according to usual custom precedes the application of varnish, ought to be proscribed as highly prejudicial when the wainscoting consists of fir wood. Sizing may be admitted for plaster, but without any mixture. A plain stratum of strong glue and water spread over it is sufficient to fill up the pores in such a manner to prevent any unnecessary consumption of the varnish.

Colour of oak wood.

The basis of this colour is still formed of ceruse. Three-fourths of this oxide and a fourth of ochre de rue, umber earth, and yellow de Berri: the last three ingredients being employed in proportions which conduct to the required tint, give a matter equally proper for distemper, for varnish, and for oil.

Colour of walnut-tree wood.

A given quantity of ceruse, half that quantity of ochre de rue, a little umber earth, red ochre, and yellow ochre de Berri, compose a colour proper for distemper, for varnish, and for oil.

For varnish, grind with a little drying nut oil, and mix up with the varnish No. 14.

For oil painting, grind with fat oil of pinks added to drying oil or essence, and mix up with plain drying oil or with resinous drying oil*.

YELLOW.

Pure and modified yellows.

Yellow, and all its transitions to the varied tones to which it is brought by art, are often employed in painting. The different bases of this colour, as well as reds, mixed with white by an expert hand, soon give the tones which approach the lights of flesh colour.

Naples and Montpellier yellow.

Naples yellow, or that of Montpellier, the composition of which is simpler, yellow ochre of Berri, or of any other place, mixed with ceruse ground with water, if destined for distemper; or drying nut oil and essence, in equal parts, if intended for varnish; and mixed up with the varnish No. 12. if for delicate objects, or with the varnish No. 14., give a very beautiful colour, the splendour of which depends, however, on the doses of the ceruse; and these must be varied according to the particular nature of the colouring matter employed. If the ground of the colour is furnished by ochre, and if oil painting be intended, the grinding with oil added to essence may be omitted, as essence alone will be sufficient. Oil, however, gives more pliability and more body.

Jonquil.

Jonquil is employed only in distemper. It may, however, be used with varnish. A vegetable colour

* See Part I. page 101.

serves it as base. It is made with Dutch pink and ceruse.

It is ground with the varnish No. 13. and mixed up with the varnish No. 14.

Lemon yellow.

A beautiful lemon yellow may be formed by following the prescription of the old painters, who mixed together red sulphurated oxide and yellow sulphurated oxide of arsenic (realgar and orpiment). But these colours, which may be imitated in another manner, have against them the unfavourable opinion occasioned by their poisonous quality. It will, therefore, be better to substitute in their room Dutch pink of Troyes and Naples yellow. This composition is proper for distemper and for varnish. When ground, and mixed with the varnishes indicated for the preceding colour, the result is a bright solid colour without smell, if an alcoholic varnish be applied for the last stratum.

Artists recommend for a straw colour a mixture of ceruse and orpiment, in doses proportioned to the required tone of colour. The case is the same in regard to the composition of the golden yellow colour about to be mentioned. The success of these mixtures is not always certain; and there seems to be reason to suppose that it arises from some deception on the part of the colourman, who substitutes for ceruse another white of an argillaceous nature. A painter one day showed me a mixture of ceruse and orpiment made in large doses for a very considerable work of a straw colour. The mixture in the course of some hours had acquired a brown olive colour. This effect could be ascribed only to the presence of orpiment, the sulphureous parts of which had exercised an action on the metallic oxide. A slight odour of sulphurated hydrogen rendered this circumstance very evident. But as the orpiment sold in the shops is sometimes the result of an artificial combination, in which the sulphur is not always united, I thought it proper to ascertain whether natural orpiment crystallized in large laminæ would produce the same change on ceruse. I tried mixtures in different proportions, all of which manifested in their tones a transition towards brown, and this transition was the more abrupt according as the orpiment predominated. These results, which accident enabled me to ascertain, have induced me to employ another basis than oxide of lead as the principal ground of the golden yellow colour, for which painters recommend ceruse.

Golden yellow colour.

Cases often occur when it is necessary to produce a gold colour without employing a metallic substance. A colour capable of forming an illusion is then given to the composition, the greater part of which consists of yellow. This is accomplished by Naples or Montpellier yellow, brightened by Spanish white, or by white of Morat mixed with ochre de Berri and red sulphurated oxide of arsenic (realgar). The last substance even in small quantity, gives to the mixture a colour which imitates gold, and which may be employed in distemper, in varnish, or in oil. When destined for oil, it is ground with drying or pure nut oil added to essence, and mixed up with drying oil.

Chamois colour. Buff colour.

Yellow is the foundation of chamois colour, which is modified by a particle of red oxide of lead (minium), or what is still better, red sulphurated oxide of mercury (cinnabar) and ceruse in small quantity. This colour may be employed in distemper, in varnish, and in oil. For varnish, it is ground with one half common oil of pinks, and one half of the varnish No. 13. It is mixed up with the varnish No. 14. For oil painting, it is ground, and mixed up with the drying oil destined for it.

Olive colour.

Olive colour is a composition, the shades of which may also be diversified. If black and a little blue be mixed with yellow, you will have olive-colour. Yellow de Berri, or of Auvergne, with a little verdigris and charcoal form this colour. It is proper for oil and for varnish.

When destined for distemper, it will be necessary to make a change in the composition. The yellow above mentioned, indigo and ceruse, or Spanish white, are the new ingredients which must be employed.

It is ground, and mixed up with the varnishes Nos. 13. and 14. For oil painting, it is ground with oil added to essence, and mixed up with drying oil.

BLUE.

Blue belongs to the order of vegetable substances, like indigo; or to that of metallic substances, like prussiate of iron (Prussian blue); or to that of stony mineral substances, as ultramarine; or to that of vitreous substances coloured by a metallic oxide, as Saxon blue. Ultramarine, in consequence of its high price, is more particularly reserved for pictures. Saxon blue even participates in some degree in this prerogative.

When prussiate of iron or indigo has been employed without mixture, the colour produced is too dark. It has no splendour, and very often the light even makes it appear black: it is, therefore, usual to soften it with white.

As much ceruse as may be thought necessary for the whole of the intended work is ground with water, if for distemper; and with oil, if for varnish made with essence, or merely with essence, which is equally proper for oil painting; and a quantity of either of these blues sufficient to produce the required tone is added.

For varnish, the ceruse is generally ground with oil of pinks added to a little essence, and is mixed up with the varnish No. 12. if the colour is destined for delicate objects, or with the varnish No. 14. if for wainscoting. This colour, when ground, and mixed up with drying oil, produces a fine effect, if covered by a solid varnish made with alcohol or essence.

In the last place, if this oil colour be destined for expensive articles, such as valuable furniture subject to friction, it may be glazed with the copal essence varnish No. 18. or that of No. 22.

This colour produces very little effect in distemper, because it is not very favourable to the play of the light; but it soon acquires brilliancy and splendour beneath the vitreous lamina of the varnish. Painting in distemper, when carefully varnished, produces a fine effect.

All painters do not place the same degree of confidence in prussiate of iron, because they are well acquainted with the instability in the tone of that colour, which passes to green more or less speedily. It is probable that the colouring parts sought for in lead and in bismuth, and which are frequently employed to lessen the intensity of the blue, contribute to produce this change. These colours acquire from the light a yellow tint, which reacts on the blue of the prussiate, and forms with it a compound colours the result of which must be a green, more or less decided. The oil may cooperate towards this effect.

According to this principle, therefore, which I think well founded, every intermediate colouring part capable of obviating this change of tint, in a manner more or less complete, must concur towards the preservation of the original colour of the prussiate of iron. Some painters employ with success umber earth and a particle of red oxide of mercury (vermilion) to fix the white of the white oxide of lead, and to prevent it from passing so easily to yellow. Blacks produce the same effect, and especially the black from vine twigs, which combines perfectly with the colour of Prussian blue. We are even assured that this mixture, made in proportions regulated by experience, exhibits under the hand of the painter a brighter and more brilliant tone, which after the lapse of several years rivals, in some measure, the blue of ultramarine.

It is well known that a mixture of prussiate of iron and the black of vine twigs exhibits, under the muller, a colour inclining to violet. It then assumes a yellowish tint, which gradually decreases, and which disappears at the end of three or four years to assume a very rich and very durable blue tone.

This mixture answers the same end in house-painting. The pearl gray assumes an azury tint, which maintains itself, and which prevents the ceruse from inclining to yellow.

Another blue made with Saxon blue.

Saxon blue, a vitreous matter coloured by oxide of cobalt, gives a tone of colour different from that of the prussiate of iron and of indigo. It is employed for sky blues. The case is the same with blue verditer, a preparation made from oxide of copper and lime. Both these blues stand well in distemper, in varnish, and in oil.

The first requires to be ground with drying oil, and to be mixed with the varnish No. 14. If intended for oil painting, it is mixed up with the resinous drying oil p. 101, which gives body to this vitreous matter.

The blue verditer may be ground with the varnish No. 1. added to a little essence; and may be mixed up with the varnish No. 3. if the colour is to be applied to delicate articles. Or the varnish No. 13. added to a little drying oil may be used for grinding; and the varnish No. 14. for mixing up, if the paint is destined for ceilings, wainscoting, or other objects of the like kind. This colour is soft and dull, and requires a varnish that may heighten the tone of it, and give it play. No. 18. is proper for this purpose, if the article has need of a durable varnish.

GREEN COLOUR AND ITS COMPOUNDS.

Sea green.

Every green colour, simple or compounded, when mixed up with a white ground, becomes soft, and gives a sea green, of greater or less strength, and more or less delicate, in the ratio of the respective quantities of the principal colours. Thus, green oxides of copper, such as mountain green, verdigris, dry crystallized acetite of copper, green composed with blue verditer, and the Dutch pink of Troyes, or any other yellow, will form, with a base of a white colour, a sea green, the intensity of which may be easily changed or modified. The white ground for painting in distemper is generally composed of Bougival white (white marl), or white of Troyes (chalk), or Spanish white (pure clay); but for varnish or oil painting it is sought for in a metallic oxide. In this case, ceruse or pure white oxide of lead is employed.

Sea green for distemper.

Grind separately with water mountain green and ceruse; and mix up with parchment size and water, adding ceruse in sufficient quantity to produce the degree of intensity required in the colour. Watin, an excellent judge in every thing that relates to sure and judicious practice, recommends the use of Dutch pink of Troyes and white oxide of lead, in proportions pointed out by experience; because the colour thence resulting is more durable.

In the case of a triple composition, you must begin to make the green by mixing Dutch pink with blue verditer, and then lower the colour to sea green by the addition of ceruse ground with water.

Sea green for varnish.

Varnish requires that this colour should possess more body than it has in distemper; and this it acquires from the oil which is mixed with it. This addition even gives it more splendour. Besides, a green of a metallic nature is substituted for the green of the Dutch pink, which is of a vegetable nature.

A certain quantity of verdigris, pounded and sifted through a silk sieve, is ground separately with nut oil, half drying and half fat; and if the colour is destined for metallic surfaces, it must be diluted with the varnish No. 12. or with No. 14.

On the other hand, the ceruse is ground with essence, or with oil to which one half of essence has been added; and the two colours are mixed in proportions relative to the degree of intensity intended to be given to the mixture. It may readily be conceived that the principal part of this composition consists of ceruse.

If this colour be destined for articles of a certain value, acetite of copper (crystallized verdigris), dried and pulverized, ought to be substituted for verdigris, and the painting must be covered with a stratum of the transparent copal varnish No. 18., or that of No. 22.

The sea greens which admit into their composition metallic colouring parts are durable, and do not change.

The last compositions may be employed for sea green in oil painting: but it will be proper to brighten the tone a little more than when varnish is used; because this colour becomes darker by the addition of yellow, which the oil develops in the course of time.

Green colour for doors, shutters, iron or wooden railing, palisades, balustrades, and for all articles exposed to the air.

A green colour is, in general, agreeable to the eye; for nature seems to have adapted the particular organization of that organ to the daily impression of this colour, which is in greater request than any other. Green and blue form separate tones, the harmony of which sympathizes best with the sensations excited through the eye. Green is the colour destined for the fields: and hence the preference given to it to harmonize with nature in the decoration of gardens and walks.

Ceruse is still the principal base of this colour. When it is required to bring it to the tone most agreeable, grind with nut oil two parts of ceruse, and with essence of turpentine one part of verdigris. Then mix up the two colours with one half common drying nut oil and one half resinous drying nut oil (p. 101). This colour appears at first to be a pale blue; but the impression of the light soon makes it pass to green, and in this state it is very durable.

Watin observes, that the doses of the ceruse ought to be carried to a third more, when the colour is destined to be employed in the centre of large cities, such as Paris: without this precaution it acquires a gloomy tone, which leads to a blackish green. There can be no doubt that this effect arises from the thick atmosphere, and the exhalations which vitiate the air in large cities. Ceruse in such places soon acquires a yellow tint, which contributes to give to the cupreous oxide a darker and more gloomy light. In these particular cases, white ought to be preferred to yellow, as the ground to a green colour. The custom among painters is to make the first coating yellow.

Compound colours for rooms.

Compound colours may be employed in distemper, or with varnish, and they will be more durable the less œconomy has been consulted in making choice of the materials, and if ceruse has been preferred to Spanish white or to chalk. In general, colours destined for varnish or for oil require a metallic white.

Compound green.

For this colour, take two pounds of ceruse, four ounces of Dutch pink of Troyes, and an ounce of the prussiate of iron (Prussian blue) or indigo. This mixture produces a green, the intensity of which may be increased or diminished by the addition of yellow or blue. You must grind with oil to which a fourth part of essence has been added, and mix up with the varnish No. 12. or that of No. 14. Both these contribute to the durability of the colour. If you are desirous of destroying the smell of the essence, form a glazing with the varnish Nos. 1. or 3. or with that of No. 6.

Green colour for articles exposed to friction and blows, such as the wheels of carriages, &c.

The great wear to which carriages are exposed by friction and continual washing, requires that a durable varnish should be employed when they are painted. Whatever care may be taken by coachmen, it is impossible that continual rubbing with a sponge, which becomes filled with earthy parts, should not produce an alteration in the best varnish. To render the work solid, you must first apply a ground composed of boiled linseed oil, ceruse previously dried over a pretty strong fire, to make it lose the white, and a little sulphate of zinc (white vitriol), in a dose of a quarter of an ounce to each pound of matter. The second stratum must be composed of the preceding green colour, that is to say, two parts of ceruse and one part of verdigris pulverized and ground with boiled nut oil, added to a fourth part of fat oil of pinks, and mixed up with drying oil. The third stratum consists of the same colour, mixed up with the fat copal varnish No. 21. or that of No. 22.

Red colour for the bodies of carriages, coach wheels, &c.

Artists differ in regard to the composition of the first strata. Watin recommends red de Berri (a kind of argillaceous ochre) mixed with vitreous oxide of lead (litharge). Others prefer red oxide of lead (minium).

Colours which have for basis a metallic oxide are always pretty durable. You may even grind with pure linseed oil or nut oil, which have not been freed from their greasy particles. Oxygen (the base of pure air), the union of which with a metallic base constitutes an oxide, does not fail, in this case, to exercise an action on the state of the oil, which soon acquires the qualities of drying oil. This effect may also be hastened by the mixture of a little sulphate of zinc (white vitriol) ground with the colour.

As this condition of the presence of oxygen is found in the red de Berri, and in red lead, either of these two substances may be employed, as the artist or amateur finds most convenient. The cheapest, however, will always be preferred. I should, therefore, take one of these two bases for the first stratum, adding a little litharge ground on porphyry, if red de Berri be used; I should grind with oil half fat and half drying, and mix up with drying oil. The second stratum should be red oxide of lead ground with drying oil, added to one half of essence. The third ought to be composed in the same manner, but with red sulphurated oxide of mercury (vermilion, cinnabar). In the last place, I would glaze the whole with the fat copal varnish No. 23., or that of No. 22., heightened with a little vermilion, and would hasten the desiccation of the varnish by exposure to the sun or to a strong current of air.

The red is often prepared, from motives of œconomy, with red oxide of lead, without vermilion.

Red for buffets.

Varnish with vermilion is not confined merely to the wheels and bodies of carriages; it often forms the ground; and in this case it ought to be treated in the same manner. It requires, however, a little more labour. After the first stratum is applied it is rubbed with pumice stone; the varnish is then laid on at several times and polished. This operation will be noticed hereafter. The same colour is employed also for internal articles of luxury. It contributes likewise to the decoration of buffets. Grind with boiled oil, added to essence, red oxide of lead, and mix up with the varnish No. 14. The second stratum is formed of vermilion, heightened with a particle of Naples yellow. Then apply a third stratum of the varnish of the second, little charged with vermilion. This varnish is very durable. It belongs to the genus of those which are susceptible of a fine polish. If you are desirous that the odour should be speedily dissipated, glaze with a varnish of the second genus; but it is less durable.

MIXED REDS.

Bright red.

A mixture of lake with vermilion gives that beautiful bright red which painters employ for the sanguine parts. This red is sometimes imitated for varnishing small appendages of the toilette. It ought to be ground with varnish and mixed up with the same, after which it is glazed and polished. The varnish No. 13. is used for grinding; No. 14. for mixing up, and No. 12. or 22. for glazing.

Crimson. Rose colour.

Carminated lake, that which is composed of alumine (the base of alum), charged with the colouring part of cochineal, ceruse, and carmine, forms a beautiful crimson. It requires a particle of vermilion and of white oxide of lead (white lead). The dearness of these two colours confines the use of this varnish to valuable articles.

Violet colour.

Violet is made indifferently with red and black, or red and blue; and to render it more splendid, with red, white and blue. To compose violet, therefore, applicable to varnish, take minium, or, what is still better, vermilion, and grind it with the varnish No. 12., to which a fourth part of boiled oil and a little ceruse have been added: then add a little prussiate of iron (Prussian blue) ground in oil. The proportions requisite for the degree of intensity to be given to the colour will soon be found by experience. The white brightens the tint. The vermilion and Prussian blue, separate or mixed, give hard tones, which must be softened by an intermediate substance, that modifies to their advantage the reflections of the light.

Chesnut colour.

This colour is composed of red, yellow, and black. The English red, or red ochre of Auvergne, ochre de rue, and a little black, form a dark chesnut colour. This composition is proper for painting of every kind. If

English red, which is drier than that of Auvergne, be employed, it will be proper, when the colour is destined for varnish, to grind it with drying nut oil. The ochre of Auvergne may be ground with the varnish No. 13., and mixed up with that of No. 14.

The most experienced artists grind dark colours with linseed oil when the situation will admit of its being used; because it is more drying. For articles without doors, nut oil is preferable. The colours of oak wood, walnut tree, chesnut, olive, and yellow, require the application of a method recommended by its success. It is even customary to add to the above ingredients a little litharge, ground on porphyry: it hastens the desiccation of the colour, and gives it body.

But if it is intended to cover these colours with varnish, as is generally practised in regard to wainscoting, they must be mixed up with essence to which a little oil has been added. The colour is then much better disposed to receive the varnish; under which it exhibits all the splendour it can derive from the reflection of the light.

This method has, no doubt, a manifest advantage in the hand of an artist who knows how to manage the application of the colour, and to give it a proper and uniform thickness, especially in the first stratum. This process, however, in regard to its complete success, depends so much on the hand and conception of the artist, that I will venture to assert, that the method I have frequently recommended of mixing up the colours with varnish, has often equalled in its effects, after application, those of the former. It appears even to be somewhat better suited to the inexperience of a young artist. Mixing up with essence, indeed, is not free from inconveniences, when the paint is applied to white wood. I have seen several of these compositions fall off in scales, in consequence either of the first stratum having been applied too thick, or without care, or of simple earths having been substituted for metallic oxides. The inconvenience, however, apprehended in the application of colours mixed up with varnish may be obviated by putting only a small quantity of colour into the last coating of varnish, to facilitate the beautiful reflection of the light from the coloured ground, or by suppressing it entirely. The varnishes which I have applied in this manner all stand the strongest blows, even with a hammer, without scaling off: they are both brilliant and durable.

By confining ourselves to the number of colours here mentioned, it may readily be conceived that we are far from the limits fixed by the different gradations or degradations of the distinct tones, modified tints, or simple shades, which would result from the variety that might be admitted in the distribution of the same colouring substances. The artist and amateur will, in this respect, foresee all the resources of the art. An examination of the determinate colours was sufficient to give a view of the means which nature puts into the hands of the colourist and painter to gratify the taste or the caprices of the opulent.

CHAPTER III.

Of the extent which may be given to the use of the turpentine copal varnishes Nos. 18. and 22. by impregnating them with various solid colouring parts, transparent and proper for answering the purpose of glazing on metallic laminæ, smooth or ornamented; for imitating transparent enamel, and for repairing those accidents which frequently happen to enamelled articles.

Residing in a manufacturing city, where the arts of enamelling and of painting in enamel have been carried to a degree of perfection hardly to be met with but in Geneva, I have often witnessed the trouble, expense, obstacles, success, and uncommon activity which always accompany the first enterprises among a people who, in point of skill and industry, approach nearer than any other to the most industrious nations.

The case with painting in enamel is not the same as with that which adds to the value of porcelain. The variety of the toys to which it is applied, their delicate forms, and the difference in the metallic alloys, require modifications in the composition of the colours, and in that of the fluxes. These modifications, the necessity of which is sufficiently shown by the accidents that happen, both in manufacturing and when out of the hands of the workman, to enamelled articles, cannot be ascertained at the moment; and there is no certain guide to direct the artist in his researches. No work but that of Montami, which is destitute of method, incomplete, and actually useless in the present state of the art, was worthy of the confidence of the enamel painter in his operations. Unacquainted, therefore, with the theory in regard to the nature of colours extracted from mineral substances, and to their degree of vitrescibility, and being under the necessity of rivaling, with success, discoveries which some adventurers, in consequence of a little more application or industry, or perhaps of a little more good fortune, were enabled to make, his attempts were always hazardous. An art thus created, in the course of two years, notwithstanding the impediments which must have resulted from the secrecy observed by workmen in the same branch of business, is one of the most singular phænomena which characterize the industry of Geneva, and the particular genius of the artists of that city.

Were the manufactory of Geneva removed to a city of the first class, such as Paris, and placed in some measure under the eye of a powerful government, where all the means of encouragement seem to be concentrated, and where the secrets of the workshop must bow under the influence of learned societies and artists, the destitute state in which the art of the enameller of toys is at present, in regard to a general theory applicable to all the valuable materials employed, would be soon observed; and this interesting part of a new branch of industry would, no doubt, find the same protection as the manufactory of porcelain has done.

It needs excite no astonishment that the art of enamelling, such as it is practised among us, where the artists live insulated, without any communication which might be of advantage to them, should, notwithstanding its success, be still deprived of those principles which could alone ensure its progress, and preserve to posterity those discoveries which by the instability of fashion may be lost. Nor can it appear wonderful that the finest master-pieces in enamel-painting, as they are so frequently subject to serious accidents, should be entirely deprived of their value, if no means can be found to repair such of these accidents as can be repaired without fire.

Toys, when once they have gone from the hands of the artist, are no longer susceptible of being renewed; but means have been found to repair with cements, which assume the solidity of a vitreous body, and which are afterwards painted and covered by a coloured varnish, the defects occasioned by small fragments being detached from certain opake compositions. In transparent enamel this reparation is more difficult. The tint of the varnish must correspond with that of the vitrified coating; it must possess the same splendour, and its solidity should be equal to that of the enamel itself. This may be accomplished by the ethereous copal varnish No. 17., and by those of Nos. 18. and 22. By introducing into the latter varnishes colours which by their tints imitate those extracted by vitrification from metallic substances, all the conditions required in the reparation of the different accidents that happen to enamel are answered; and at the same time a new art is created, which I have had the happiness to see realised.

Simple copal varnish, or that made with turpentine, has an ambery colour, which disappears when it has been applied. The oily substance, by contributing to its solidity, renders it at the same time very proper for becoming charged, much better than alcoholic varnishes, with certain vegetable resinous colouring bodies, by means of which the artist can, in a certain degree, imitate those colours which produce so beautiful an effect in transparent enamels. It may be readily conceived, that to preserve to these varnishes this transparency, which gives them a resemblance to enamel, nothing must be employed but resinous or saline matters, entirely soluble in essence. It was in this manner I prepared the colours applied to the lid of the ivory box I presented to the Society of Geneva as a specimen of the new manufacture in coloured varnishes imitating enamel; and for which I was indebted to the gratitude of a countryman, for whom I had prepared the varnish.

The varnish which serves as a glazing*, and which is susceptible of a fine polish, resists better than the vitreous flux of enamels, the friction of keys, boxes, and other articles very often carried in the pockets. The daily use made of this box for twelve years, has destroyed the metallic ring which served it as an ornament, but without injuring the varnish.

* To glaze, in the language of painting, expresses the application of a stratum of transparent matters on a coloured ground in such a manner that the colour of this ground becomes more apparent, more brilliant, or lighter. To glaze, therefore, is to apply a colour which has little body, or a transparent tint which suffers the ground on which it is placed to be seen.

Mr. Chaponier, the artist who found means to make so successful an application of copal varnish, according to my process, quitted Geneva, his native country, some time after he had been employed on this new art. His success has induced me to devote this chapter to the coloration of this varnish.

Transparent green colour.

Artists are often embarrassed in regard to the choice of colouring matters, when they are desirous of communicating a colour to a liquid without injuring its transparency. Some colouring parts are susceptible of being transmittted to alcohol, or even to water, but refuse to unite with oily substances. Cupreous preparations, in the saline state, are of this nature; while cupreous oxides (calces of copper) resist the action of water, and pass into oily liquors. Other colours require mordants of an acid or alkaline nature before they become disposed to pass into water, and refuse every kind of union with oils. Indigo, litmus, cochineal, saffron, bastard saffron, and red sandal wood, prove the truth of this principle, which experience has induced me to admit.

This variety in the chemical properties of colouring substances seems to confine the application of some of them to certain vehicles and to certain circumstances, in order to render them useful in the arts. I have often experienced difficulties when, on the faith of authors who have written on this subject, I endeavoured to give to copal varnish made with turpentine all the colours susceptible of producing a rich effect in painting, without altering the transparency of the coloured vehicle. It must, however, be allowed that the state of the body employed in these trials is not always what it might and ought to be, if taken from the order of saline substances. One example will be sufficient to show the truth of this observation.

I mixed acetite of copper (crystallized verdigris) reduced to powder, with copal varnish, to communicate to it a transparent green colour. The union which I attempted was favoured by the heat of a balneum mariæ. At the moment of the mixture a part of the copal assumed the form of grains; but by the addition of a little turpentine, the temperature of the bath, and motion, the varnish was at length restored.

In my opinion, this separation of a part of the copal was owing to the presence of the moisture contained in the pulverized crystals; for, having repeated the same experiment with pulverized acetite of copper, perfectly dry, projecting the powder in small portions into the hot varnish, it was attended with complete success. The colour resulting from this mixture was a beautiful green. It was mellow, and abundant in colouring matter, since one coating of it, extended over a metallic plate, produced under this colour a reflection of light of a very rich and agreeable tone.

Another green colour.

The green oxide of copper, obtained by precipitating with liquid carbonate of potash (potash) a solution of copper in any acid, if washed and dried, and then mixed with copal varnish, gives a beautiful green colour. It is inferior, however, to the preceding composition.

Another green colour by composition.

This green may serve as an illustration of the theory of compound colours. The mixture of two simple colours produces a compound colour, the more or less decisive tint of which depends on the respective quantities employed. The varnish coloured by terra merita or gum guttæ, Nos. 15. and 16., mixed with the following varnish coloured by pure prussiate of iron, is more beautiful, smoother, and more extensible than the green formed by acetite and by precipitated green oxide of copper.

Blue colour.

If indigo could incorporate with copal varnish, and communicate to it its colour, we should not be obliged to search for this colour in a substance which alters its limpidity, and which renders it coloured only in consequence of the great division of its parts. Prussiate of iron (Prussian blue) serves as the basis of this colour.

The Prussian blue of the shops, when of the first quality, communicates to our varnish a very transparent blue colour; but it has not that richness of reflection and velvety appearance which renders it agreeable to the eye when that extension which it can bear without being weakened has been given to it. When extended over a metallic plate, there are even observed in it grains, which one is tempted to ascribe to the effect of incomplete division, or to the separation of some earthy matter, which almost always accompanies the best prussiate of the shops.

At the time of my researches in regard to this colour, I had in my possession a prussiate, which I had made in the experiments repeated during the course of my lectures, and which was absolutely free from any mixture of alumine (the basis of alum). I employed it for the coloration of varnish, and the trial was attended with complete success. In a word, this blue, when in a state of purity, unites so completely with copal varnish that its transparency does not seem to be in the least affected by it*.

* It is not necessary that artists should make prussiate of iron in order to obtain it pure; any one possessed of common intelligence may easily separate from that of the shops the alumine or argillaceous base arising from the decomposition of the alum employed in the preparation of it. Pulverize the blue, and put it into a glass or porcelain vessel with a mixture of water and muriatic acid (marine acid); a very strong effervescence will take place. When the effervescence has subsided, pour in a new quantity of acid: if no effervescence ensues, it will be sufficient to add to the liquor of the prussiate a very small portion of acid. Then leave the mixture for twenty-four hours, and at the end of that period decant the clear liquid. Wash the sediment with boiling water; and having poured the whole on a paper filter, throw water on the filter till it becomes insipid. Then dry the blue remaining on the filter, and divide it under the muller. The quantity will be lessened; but the intensity of the colour will be much greater. After this process the prussiate may be considered as free from mixture; and this is the state in which it ought to be for the present purpose.

Superb liquid blue.

Circumstances sometimes occur to authorize the application of copal varnish to a colour which may have been mixed up with a gummy or mucilaginous liquid. These circumstances are favoured by the accidents which happen to enamel. Opake enamels are able to support the impression resulting from the direct application of a mineral acid to a metallic plate; and in like manner, transparent enamels, applied to gold and silver, can admit for their reparation colours, the mordant of which may be taken from the order of mineral acids, attention being however paid to their particular affinities. In regard to metals, the texture of which is inferior to that of gold or silver, colours with a mordant can be applied only by means of a gummy juice capable of defending the metallic plate from the contact of the mordant. The colour, the composition of which I am about to describe, as well as that from indigo, which I shall speak of hereafter, belongs to those which require this preliminary precaution. I made a trial of it about thirty years ago with a celebrated draftsman, known by his zeal and superior talents, which he devoted to the honour of his country, Geneva; for it was to the advice of Soubeyran, and the confidence placed in him by government, that we are indebted for the establishment of the drawing-school entrusted at present to the particular direction of the Society of Arts, which has added to it a school for modelling and an academy. The above artist applied this blue to fanpainting, &c., and set the highest value on it. The composition of it is as follows:

Put into a small matrass or common phial an ounce of fine prussiate of iron (Prussian blue) reduced to powder, and pour over it from an ounce and a half to two ounces of concentrated muriatic acid (fuming marine acid). The mixture produces an effervescence, and the prussiate soon assumes the consistence of thin paste. Leave it in this state for twenty-four hours; then dilute it with eight or nine ounces of water, and preserve the colour, thus diluted, in a bottle well stopped.

The intensity of this colour, which is very dark, may be lessened, if necessary, by new doses of water. If the whole of this mixture be poured into a pint of water*, it will still exhibit a colour sufficiently dark for washing prints.

This colour charged with its mordant requires the use of gum water made with gum tragacanth. Mucilage of gum arabic does not possess sufficient consistence.

This colour applied with gum water, and covered, when dry, with copal varnish, would form very beautiful foil.

Yellow.

Gum guttæ and terra merita give very beautiful yellows, and readily communicate their colour to copal varnish made with turpentine. Aloes give a varied and orange tint.

* The French pint is about an English quart.

Dark red.

Dragon's blood infused warm in varnish gives reds, more or less dark, according to the quantity of the colouring resin which combines with the varnish. The artist, therefore, has it in his power to vary the tones at pleasure.

Though cochineal, in a state of division, gives to essence very little colour in comparison of that which it communicates to water, carmine may be introduced into the composition of varnish coloured by dragon's blood. The result will be a purple red, from which various shades may be easily formed.

Violet.

A mixture of carminated varnish and dragon's blood, added to that coloured by prussiate of iron, produces violet.

I shall not give more examples of the communication of colours to copal varnish, as every person habituated to the operations of this art, and every amateur possessed of a certain share of dexterity, may readily find any tone of colour he desires. But, what is of most importance to be considered in the reparation of enamel, is the necessity of embracing the whole of the subject exhibited by the painting, the injuries of which are to be repaired, and of entering into the idea of the artist by whom it was executed. This condition, which relates in an essential manner to the subject, seems to require, for the reparation of it, the hand by whom it was first painted.

Observations.

The use of copal varnish cannot be confined to the purposes already enumerated. Hitherto I have considered it as forming part of the province of the painter, rather than that of the varnisher. This varnish is called to another destination, which displays better its properties and the extent of its utility. The reader, from what has been already said, must be convinced that, if carefully applied, it is capable of producing great richness, splendour, and solidity, when extended over surfaces which are themselves possessed of splendour, as is the case with metallic substances. This physical quality, observed in the latter, and the solidity of their texture, render them proper for articles subject to blows or to continual friction, and exposed to the alterations occasioned by humidity. The application of a varnish sufficiently solid to resist these different causes of alteration, and sufficiently transparent to preserve and even to increase the original metallic splendour, must add, in a considerable degree, to the value of these articles. Mathematical, astronomical, and philosophical instruments show, in an evident manner, the advantages which they derive from similar compositions.

When the copal varnish is destined for small articles, as a particular distribution of the colours is not required, it may be applied as well by an amateur as by a professed varnisher. But if large articles are to be varnished, the application of it requires practice and great care.

One of the essential conditions relates to the state of the metallic surface. It must be well polished, that is to say, better than in common. It must then be heated on an iron plate placed over a chaffing-dish till the hand can scarcely bear to touch it; and the heat must be equally distributed to every part of it.

When this is done, dip in the varnish a large flat brush, made of very soft hair, and draw it gently over the whole article. This operation requires dexterity, that the different strokes of the brush may not be observed. It will, therefore, be proper not to load the brush with too much varnish at once: if these precautions are neglected, the surface of the metal will exhibit undulations, and very often it will be spotted. Turned articles, if varnished while in the lathe by means of heat, will always be attended with the greatest success, because the extension of the varnish is more uniform, and the operation facilitates the polishing. When undulations are observed, this defect may be, in part, remedied by making the article approach the iron plate without bringing it into actual contact. The distant impression of the heat renders the varnish more uniform.

If a gold colour be required, two or three successive strata of coloured and changing varnish may be applied; and these must be covered by a last stratum of the uncoloured copal varnish, No. 18. The colouring parts of the changing varnish of the third genus, No. 15., may also be communicated to the copal varnish; or you may employ the new varnish, No. 22., made with copal of one fusion.

If particular circumstances, determined by the nature of the article intended to be varnished, prevent its being heated, the varnish must be applied cold; but the article may be brought near to the fire, or exposed in a stove, the heat of which disposes the varnish to extend itself in a more uniform manner, and to appear with its whole lustre. A bright sun and pure air produce the same effect.

If these kinds of varnish become stained by use, the article must be washed with tepid water, and wiped with a piece of fine linen rag. The contact of hard bodies is hurtful to them. If the case require it, a little soap may be added to the warm water.

Application of copal varnish to the reparation of opake enamel.

The properties manifested by these varnishes, and which render them proper for supplying the vitreous and transparent coating of enamel, by a covering equally brilliant, but more solid, and which adheres to vitreous compositions and to metallic surfaces, admits of their being applied to other purposes besides those here enumerated. By slight modifications they may be used also for the reparation of opake enamel which has been fractured. These kinds of enamel admit the use of cements coloured throughout, or only superficially, by copal varnish charged with colouring parts. On this account they must be attended with less difficulty in the reparation than transparent enamel, because they do not require the same reflection of the light. Compositions of paste, therefore, the different grounds of which may always harmonize with the colours or ground of the pieces to be repaired, and which may be still strengthened by the same tint introduced into the solid varnish, with which the articles are glazed, will answer the views of the artist in a wonderful manner.

The base of the cement ought to be pure clay, without colour, and exceedingly dry. If solidity be required, ceruse is the only substance that can be substituted in its place. Drying oil of pinks will form an excellent excipient, and the consistence of the cement ought to be such that it can be easily extended by a knife or spatula possessed of a moderate degree of flexibility. This sort of paste soon dries. It has the advantage also of presenting to the colours, applied to it with a brush, a kind of ground which contributes to their solidity. The varnish No. 1., of the first genus, is exceedingly drying. The application of it will be proper in cases when speedy reparation of the damaged articles is required.

In more urgent cases the paste may be composed with ceruse and the copal varnish No. 18. or 22., which dries more speedily than oil of pinks; and the colours may then be glazed with the ethereous copal varnish, of the fourth genus, No. 17.

The application of the paste will be necessary only in cases when the accident, which has happened to the enamel, leaves too great a vacuity to be filled up by several strata of coloured varnish. But in all cases the varnish ought to be well dried, that it may acquire its full lustre by polishing.

Though it may be more convenient to apply the paste, and then to colour it superficially by strata of colours analogous to the subject, cases may occur in which a preference ought to be given to cements coloured throughout their whole substance; and though any artist may easily determine the kind of matter proper for the purpose, it will no doubt be of some utility to give a short view of the colouring substances recommended by experience.

White.

White oxide of lead, ceruse, Spanish white, white clay. Such of these substances as are preferred ought to be carefully dried. Ceruse and clays obstinately retain a great deal of humidity, which would oppose their adhesion to drying oil or to varnish. The cement then crumbles under the fingers, and does not assume a body.

Black.

Lamp black, black made of burnt vine twigs, black of peach stones. The lamp black must be carefully washed, and afterwards dried. Washing carries off a great many of its impurities.

Yellow.

Yellow oxide of lead of Naples and Montpellier, both of them reduced to impalpable powder. These yellows are hurt by the contact of iron and steel: in mixing them up, therefore, a horn spatula with a glass mortar and pestle must be employed.

Gum guttæ, yellow ochre, or Dutch pink, according to the nature and tone of the colour to be imitated.

Blue.

Indigo, prussiate of iron (Prussian blue), blue verditer, and ultramarine. All these substances must be very much divided.

Green.

Verdigris, acetite of copper (crystallized verdigris). Compound green (a mixture of yellow and blue). The first two require a mixture of white in proper proportions, from a fourth to two-thirds, according to the tint intended to be given. The white used for this purpose is ceruse, or the white oxide of lead, or Spanish white, which is less solid, or white of Moudon.

Red.

Red sulphurated oxide of mercury (cinnabar vermilion). Red oxide of lead (minium). Different red ochres, or Prussian reds, &c.

Purple.

Cochineal, carmine, and carminated lakes, with ceruse and boiled oil.

Brick red.

Dragon's blood.

Chamois colour.

Dragon's blood, with a paste composed of sublimated oxide of zinc (flowers of zinc), or, what is still better, a little red sulphurated oxide of mercury (vermilion).

Violet.

Red sulphurated oxide of mercury mixed with lamp black, washed and very dry, or with the black of burnt vine twigs; and to render it mellower a proper mixture of red, blue, and white.

Pearl gray.

White and black; white and blue; for example, ceruse and lamp black; ceruse and indigo.

Flaxen gray.

Ceruse, which forms the ground of the paste, mixed with a small quantity of Cologne earth, as much English red, or carminated lake, which is not so durable, and a particle of prussiate of iron (Prussian blue).

Remarks.

It is well known that these mixtures will not admit of any fixed rules, in regard to the quantity of the matters which enter into their composition. They must depend on the taste of the artist, and the tone he is desirous of giving to the colour.

All these different methods seem to approach, more or less, to a kind of painting which maintains a very lucrative branch of manufacture, and gives employment to a number of hands. I here allude to the preparation of foils, or coloured laminæ, used with so much success in the manufacturing of buttons, in embroidery, and for ornamenting a variety of toys, of which there is a very extensive and daily consumption. These very thin laminæ of silver, copper, brass, or tin, perform the same office, under the name of foil, as enamel covered with copal varnish, coloured or not coloured, and which may be distinguished by the name of *false enamel.* If the latter seems to differ from foil, by the consistence, which depends on the thickness given to the metallic laminæ, and the successive application of several strata of solid varnish; if they differ also by the body itself of the varnish, which does not admit of those *sauces* which constitute the colouring part of foil, they seem to have some resemblance to them by the nature of their composition, though it still appears to be involved in mystery. I, however, think it my duty to lay before the reader the only information I have been able to procure in regard to the preparation of foil, with a view of gratifying those who may be desirous to carry their researches further, and to unite this branch to the art of varnishing, to which it really belongs.

Foil.

The reader must here recollect, that certain colouring parts of an extracto-gummy nature are more disposed, by this circumstance alone, to pass into water than into alcohol or into essential oils; that other colouring parts, such as those extracted from mineral substances, experience only a great division, as is the case with prussiate of iron, green oxides of copper, &c. When the nature of the colouring parts which ornament different kinds of foil is examined, it does not always occur that they may be owing only to coloured varnishes. In the course of my researches I think I have observed, that some of these colouring parts belong to that kind of compositions distinguished by the technical appellation of *sauce*, covered afterwards with a transparent varnish, which preserves them from the influence of moisture, and which concurs with the metallic splendour to produce that beautiful effect with which, in general, they are attended. The processes can be varied, in regard to the tone and shades of the colours, which may be easily rendered stronger or weaker. Those which I here offer produced, in part, the desired effect.

First preparation.

Immerse fish glue in pure spring water for twenty-four hours, and then expose it to the action of boiling water, to complete the solution of the gelatin (the base of strong glue extracted from animal substances). Strain the whole through a double piece of linen, or a piece of flannel, and evaporate it in such a manner that the solution of the gelatin shall form itself into a trembling jelly; that is to say, not too thick when exposed in a cellar for two or three hours.

Second preparation.

Dip the polished metallic leaves of copper, brass, or tin (the latter are employed only for gilt leather, and for decorating papier maché), which you wish to colour, in water impregnated with a little nitric acid (aquafortis), for example an eighth, a tenth, or a twelfth of acid. This immersion renders the surface of the metal rough. Then wipe it carefully at the moment, and having applied the glue suffer it to dry, that it may then receive the colour.

Blue colour.

The beautiful liquid blue, the composition of which has been given p. 420, may be employed for this purpose. Leaves of silver or copper ought to be preferred to those of brass, when colours with a mordant are applied. Any degree of intensity may be given to this blue by the addition of common water.

Another blue.

Take one part of Guatimala indigo, and put it into a phial placed in hot sand, with two parts of common sulphuric acid (oil of vitriol). When the effervescence which takes place has subsided, add ten or twelve parts of pure water. This kind of solution renders the blue very beautiful. It is the composition of the Saxon blue. The observations made in treating of the preceding blue, in regard to the nature of metallic laminæ, may be applied to this kind of colour. They ought to be copper or silver.

Green.

A compound green may be made by mixing a decoction of yellow berries with a little blue liquor. It may be prepared also by the immediate employment of a solution of acetite of copper (crystallized verdigris), such as that described under the head acetite of copper. The sea green also may be imitated.

Red.

A dark red may be extracted from a decoction of cochineal, the tint of which can be varied by means of a large dose of water. This red inclines to purple.

The red of sandal wood may be extracted by alcohol, the evaporation of which will furnish the means of concentrating this colouring part. The colouring part may be extracted also by water, which must afterwards be evaporated, and the extract is then mixed with alcohol.

A process nearly similar may be employed to apply to foil the rose colour of bastard saffron. This colouring part is soluble in carbonate of soda (crystals of soda), as already seen, p. 360. It is precipitated from the soda by means of the acid of lemon juice, which seizes on the alkali. For the present operation this colouring part is separated from the supernatant water by means of some slips of cotton cloth, or cotton wicks, one end of which is immersed in the liquid, while the other hangs over the edge of the vessel. All the water is thus drawn off as if through a filter. The colouring part is then mixed with alcohol, and spread over the metallic surfaces in successive strata.

Violet.

Tincture of litmus, the colouring part of which passes readily into water, produces a coarse violet. It may be brightened by using alcohol, which acts on it as well as water. In the latter case, therefore, alcohol is taken as the principle of solution.

The colouring part of litmus is held in solution by ammonia (volatile alkali) disengaged from urine by putrefaction. The colouring part which has passed into the water, in the case of an aqueous decoction, is precipitated by the addition of a little acid of lemon: it then collects itself at the bottom of the vessel. To separate the supernatant water, the same kind of filtration as that used for the decoction of bastard saffron may be employed; or it may be removed by alcohol, in which some drops of liquid carbonate of potash (oil or solution of the salt of tartar) have been poured, to brighten the colour and to change it to a beautiful violet. Concentrated decoction of litmus, applied to metallic laminæ, furnishes a speedier method of coloration.

Lilac.

Tie up the litmus in a knot, and immerse it in water till it give only a rose colour. Then boil it in a new quantity of water, in which the remaining colour will be concentrated, and apply this decoction cold to the metallic laminæ, prepared with a solution of fish glue.

Ruby colour.

Boil carmine or carminated lake in water; and when the decoction rises add some drops of ammonia (volatile alkali). Suffer the liquor to form a deposit cold, and employ it without filtration. A decoction of cochineal, in my opinion, might be substituted for the carmine or the lake.

Rose colour.

To make rose colour, add to the preceding a new quantity of water, until it is brought to the tone required. Bastard saffron gives, in the gradation of its colour, different shades of rose colour. A decoction of Brasil wood, mixed with a solution of tin in nitric acid, gives also tones of rose colour.

Ponceau. Poppy red.

Extend a stratum of the ruby colour, and over it another of the tincture of oriental saffron, extracted by maceration in cold water for forty-eight hours.

Capuchin colour, yellow and jonquil, might be made in this manner, by giving stronger or weaker doses of colour.

Prune colour, and other browns.

A stratum of lilac colour, and over it a stratum of green or blue.

Observations.

The second and third strata of colours ought not to be applied till the preceding is perfectly dry. Care must be taken also not to pass several times over the same place, because the new colour, though cold, loosens the former. It is, therefore, always advantageous to give to the colour a very dark tint; because it saves the trouble of going too oft over the same surface.

These different tints of colours would not have the durability observed in foil, and would be easily effaced by the effects of rain or of fogs, were they not preserved by being covered with varnish. The varnishes generally appropriated to articles of this kind are those which compose my first genus; that is to say, drying varnishes made with alcohol. No. 1., 2., and 3., therefore, may be employed in such cases; and, for the better preservation of the tints, the copal varnish No. 18. or No. 22., of the fourth genus, may be used. At first it will emit some smell, but this may be remedied by a stratum of alcoholic varnish. Articles of this kind do not require much durability in the varnish.

CHAPTER IV.

Precepts respecting the application of varnishes, coloured or not coloured, which the artist or amateur ought always to keep in remembrance. Of the different kinds of painting. Of varnished linen and silk.

The best composition of varnish, and the most exact combinations in the colours, are not sufficient to call them forth with all that splendour which it is possible to give to them. An expert hand is required also for the application of them; and the amateur who has not been accustomed to the labour must possess a correct taste.

The instruments which painters employ are simple, and few in number. A smooth stone, a muller, a spatula, a flexible knife to bring under the muller the colours scattered over the grinding stone, or to remove them; brushes large and small, and a few pots for mixing up the colours, form the whole apparatus necessary for the amateur in the employment of varnishes and colours.

The colours cannot be used in that state in which they are purchased in the shops. They require to be purified, ground, and mixed with the different liquors which art employs to facilitate the extension of them over the articles intended to be painted; and these liquors must be different, according to the nature of the colouring parts, and to the uses for which the articles are destined: they are determined also by the consistence which must be given to the composition.

It will therefore be necessary to offer a few observations on this subject:

1st. The hard bodies are pulverized, and sifted through a hair or silk sieve. This preliminary preparation is applied to the different kinds of ochre, chalk, clays, or boles; and to solid substances, such as white lead, litharge, verdigris, and cinnabar. This operation prepares them for being more completely divided under the muller, and facilitates the separation of bits of straws, fragments of wood, or other foreign bodies, which are often met with in some of the common colouring substances.

2d. When the colours are to be applied to painting in distemper they are ground in water, that the lightest particles may not escape, in consequence of the motion excited by the muller. The ground matter is reduced to the consistence of thin paste; and when the muller glides over the stone, without making any noise, and when the trace it leaves on the colour is smooth and without grains, it is judged that the operation has brought it to the required state of division.

3d. Certain genera and species of varnish destined for delicate articles, which are frequently exposed to carriage, as boxes, &c. and certain toys, such as fans, boxes for holding counters, &c. do not admit in their composition any matter capable of communicating to them a strong smell, or which would render the desiccation of them slow. In these particular cases the varnishes of the first and second genera are to be preferred. The colours are then ground with the varnish No. 1., to which is added a spoonful or two of oil of pinks to render it pliant; and the colours are mixed up with the same varnish. But, as it evaporates very speedily, it requires to be employed immediately.

4th. Under some circumstances a more solid varnish than those of the first two genera is required for mixing up certain colouring parts; such, in particular, as those extracted from the mineral kingdom, which have a character of dryness that must be counteracted or modified. The colours, in this case, are ground with drying oil, to which a little fat oil has been added. At other times the colours are mixed up with a varnish of the third genus, such as that of No. 14.; or of the fourth genus, as the copal varnish No. 18. When the dryness of the colour or drying quality is not very great, it may be ground with the varnish No. 13., and mixed up with that of No. 14., which belongs to the fourth genus.

5th. There are other circumstances which require greater solidity in the varnish, and which proscribe every liquor or excipient not capable of concurring to promote this essential quality. In this case the colours are ground with drying oil, to which a little fat oil has been added, if the colour contains a considerable quantity of metallic oxide. If this oil renders the matter too thick, a little essence is mixed with it; and it is then diluted with the resinous drying oil, p. 120, or with one of the fat varnishes of the fifth genus.

6th. One of the most essential points to be observed in the preparation of the colour is, as already said, the extreme division of its parts. Grinding in water is speedily performed. This liquid, by its nature, easily loosens the aggregate moleculæ of earthy substances. The case is not the same when varnish, essence, or oil is employed. The experienced artist, who attends to the gain arising from his labour, will readily be sensible of the utility of this precept. Habit will soon teach him, that a colour becomes truly profitable only when it has been reduced to the utmost state of division. He will not, therefore, consider the time which he employs in the operation. But the amateur, who has not the advantage of experience, soon becomes tired of the labour, which appears to him fatiguing: he consequently gives way to impatience, or to the ardent desire he has of realizing the effect of the intended decoration. It will, therefore, be proper that he should coolly consider the inconveniences which result from precipitation, and frequently call to mind those precepts, founded on experience, which can alone ensure success.

The great division of colours is one of the principal causes of their beauty, and of the mellowness of their tones. The play of the light is then freer; it is purer, and more disengaged from those partial reflections which in a granulated colour compose the coloured reflected ray, the brightness and splendour of which are then much altered.

7th. Three of our senses concur to determine the essential point of this division, namely, the touch, sight, and hearing. One may readily perceive that a colour grinds more easily at the commencement than at the end of the operation. The granulated parts roll with greater freedom under the muller than when they are more attenuated; and the muller rises more easily at the beginning of the operation than when it is nearly finished. The air disseminated in the interstices of the still coarse matter lessens and counteracts the force of adhesion, which the weight of the atmosphere establishes between the muller and the grinding stone. The hand which maintains the circular motion may, therefore, easily distinguish when the division of the parts has attained to its utmost term.

The fineness of the parts may be soon observed by the sight. The trace of the muller shows the matter smoother, and the colour is more and more developed: but if the eye is sufficient to perceive this physical change, it is soon distinguished also by the ear.

At the commencement of the operation of grinding, the rolling and friction of the parts of the matter and of the instrument excite under it a kind of noise, which gradually decreases, and which is scarcely heard towards the end. The absorption of the oily fluid, which becomes greater as the division of the parts is completed, requires the addition of more colour to bring the mixture to a proper consistence. Care, however, must be taken not to render it too liquid; because it would run on the stone and retard the term of division, in consequence of the addition of a little solid matter which would become necessary. A pretty liquid consistence is less fatiguing, but the act of division is somewhat retarded. On the other hand it is the more rapid as the consistence of the matter is thicker: hence time is gained at the expense of a little more fatigue. Two or three trials will soon indicate the true consistence proper to be given to the matter to render the operation easy and expeditious.

8th. The perfection of this operation, and the speediness of its execution, depend on the quantity of the substance subjected, each time, to the action of the muller. Those who might believe that the process would be hastened by employing a great deal would be much mistaken: there is no fixed rule in regard to this point. It depends on the extent of the stone, the length and strength of the workman's arms, and consequently on the greater or less restraint he may experience in keeping the muller in continual motion. When heavy matters, such as those obtained from metallic bodies, are ground, eight ounces at once will be sufficient.

9th. When the grinding is finished the matter is removed with a flexible knife or spatula, and put into a colour-pot. The same operation is repeated with new doses of matter, till the whole quantity judged to be necessary for the work is ground with the same care. The colour is then diluted with the varnish or prepared oil intended to be employed, giving it the proper consistence. This is what is called, according to the technical term, *mixing up the colour*. In this respect extremes must be avoided; a colour when too liquid runs, and does not cover with sufficient exactness the article which has been painted: if too thick it forms lumps, can with difficulty be extended, occasions more expense, disfigures the work, and fatigues the hand which applies it. The colour on being taken from the pot ought not to drop from the brush when turned round two or three times in the hand, raising it obliquely to check the thread which is formed.

Should the colour, during the operation of applying it, assume too much consistence, a little more varnish must be added, if it has been mixed up with varnish; and essence of turpentine, if it has been made with the latter or with oil. But if this consistence of the colour arises from that of the varnish, it will be proper to heat the alcohol or essence, before it is added to the mixed up matter, in order to prevent the precipitation of a part of the resin of which the varnish is composed.

10th. All matters destined for priming are ground with water*, or with alcohol (spirit of wine), or with essential oils, such as that of turpentine, or with fat drying oils.

Colours ground with alcohol, and which are mixed with varnish, must be employed immediately; but the great volatility of alcohol, and the rapidity with which it evaporates, render this kind of process inconvenient. On this account the varnish with which the colour is to be mixed up is substituted in its stead; and each time that a new quantity of colour is put on the stone a spoonful of drying nut oil is added, if the colour can bear the slight change in the tint which results from it; or with the same quantity of oil of pinks, if the nature of the ground proscribes the use of every thing that might communicate a foreign tint.

11th. When colours are ground in essence, the artist ought to stand where there is a current of air, to

* This is the case in regard to distemper.

avoid the emanation of the essence, which sometimes exercises an action on the nerves, when one is too long exposed to it.

In other cases the colours must be ground with drying oils or with varnishes of the fifth genus, the consistence of which requires that they should be mixed with a half or a third of essence of turpentine. This is the practice followed in regard to copal and amber varnish, and in regard to all colours destined for oil painting.

12th. Each kind of varnish is reserved for uses which, in some measure, limit or distinguish the cases of its application. The clear, brilliant, delicate varnishes, which constitute the first genus, are not proper for coloured grounds: they are too tender. Blows and friction render them mealy. They may be applied with more success to articles ornamented with cut paper, and to furniture belonging to the toilette. Varnishes which have somewhat more body, such as those of the second, third, and even the fourth genus, are much better suited to the coloured grounds which cover wainscoting, ceilings, cornices, and all works sheltered from the influence of moisture and of rain. In the last place, articles exposed to the open air and to the inclemency of the weather, or which are liable to shocks or to friction, do not admit of secondary varnish. They require a consistence and solidity which is found only in fat varnishes and in oil colours.

13th. In all cases which require the use of compound colours, it will be proper to treat each of them separately. When this labour is finished, the mixture can be made with more precision.

14th. Painters employ two methods for varnishing apartments. Some apply the colouring substance in distemper,—a process which will form the subject of the following chapter,—and then cover it with as many strata of varnish as the object may seem to require, with or without colour. Others grind and mix up the colour with varnish, which in this case serves as a vehicle.

To both these methods objections have been made. The second appears to me to be accompanied with some advantages not to be found in the first.

Distemper causes the wood to swell, and deposits on it a kind of plaster, which the least percussion often detaches in large scales. When this method is followed, it will be necessary to leave such an interval between the application of the distemper and that of the varnish as may give the wood time to dry. If this precaution be neglected, which is almost always the case, the varnish applied to this size penetrates into it, if it has not been very strong: but it is prevented from reaching the wood by the effect of the moisture concentrated in it, and which opposes every kind of union with the resins that form the base of the varnishes. The varnish then gives to the coloured stratum the hardness of cement, which does not yield to the shrinking experienced by the wood as it dries, and which falls off in laminæ, merely by the effect of desiccation. These results, which are frequently ascribed to fraud, attest only the ignorance of the painter, or the impatience of the amateur, who has been too precipitate in the application of his colours.

The case is not the same with the second method, especially if the varnish be applied when the wainscoting is dry, and if the first stratum be employed very clear, to dispose the wood to imbibe the varnish. The successive strata of colour incorporate then with the first, which adheres to the wood, and which, by these means, secures it from the impression of the moisture of the atmosphere. The last consideration ought not to be neglected, in a country like ours (Geneva), intersected by a large lake and by rivers, exposed for five months of the year to the influence of fogs, and where fir wood only is employed for wainscoting. In regard to the wainscoting destined for lower halls exposed to moisture, this precaution is carried still further, by covering the back of it with oil painting made with bole. The same practice is adopted with advantage for the inside of the boxes of an orangery.

The mixture of colours with varnish requires that a little colour only should be added to the varnish applied as the last stratum. There are even some cases which require it to be absolutely colourless. It then forms glazing, and its brilliancy is greater: the colour also is more nervous.

All the reasons here given for preferring the second method must be felt and appreciated by the amateur desirous of giving to his compositions that solidity of which they are susceptible; but they have not the same value in the eyes of the artist, who attends only to the profit arising from his labour. The use of size produces a considerable saving of varnish, which is far more expensive. Besides, the splendour which he is able to give to this last stratum conceals the imperfection of an unequal coating of the colour, which however may possess some solidity, if it be applied in summer, and if care has been taken to allow the size sufficient time to dry, so as to prevent the shrinking of the wood. But this last condition does not accord with the haste and dispatch which the painter employs in the execution of such works.

One particular circumstance, however, seems to proscribe the use of size: that is, when it is required to apply varnish to new plaster. A solution of Flanders glue in water, which ought not to be too strong, and which is applied warm, that it may penetrate the plaster, is then used. But it will be proper to leave the plaster time to exhale all its moisture before it be covered with the glue.

Another method, very favourable to the preservation of wood, and proved to be useful in checking the effects of moisture, is sometimes employed. It is to prime the wood with ceruse, to which a sixteenth part of the vitreous oxide of lead (litharge) has been added. These oxides are ground with oil and one third of essence. Colours in varnish, applied to this first stratum, penetrate into the wood, and acquire splendour and a mellow tone, together with consistence, when the varnish is well chosen. I found this method to answer exceedingly well.

15th. A careful artist, who wishes to give to his colours on wainscoting all the splendour they are capable of acquiring from a free reflection of the light, does not fail to remove, after the application of the first stratum, all the small inequalities which may occur on the surface, and particularly those rendered more apparent by the knots and fibres which rise from the wood. He rubs pumice stone gently over these inequalities. This operation can be performed in a perfect manner on every kind of painting, but in particular on that with essence: it adds greatly to the uniformity of the tone and splendour of the varnish. It is always understood that ceilings, if they are old, must be carefully cleaned and brushed, to remove the dust which becomes incrusted in the mouldings.

16th. The reader, in perusing the detached observations which accompany the different formulæ for the preparation of varnishes, must have been struck with the preference which I establish in favour of the compositions of the third, and even of the fourth genus, in all cases of house-painting, to the detriment of those which constitute the first two genera. There are some varnishes, however, of the first and second genera which may answer the proposed views: but, in general, the consistence and tenacity of varnish made with essence are not to be expected from alcoholic varnishes. Persons of delicacy may be hurt by its strong odour, and may even consider this as a motive for excluding it. But this motive vanishes in summer, and when the apartments are not occupied too soon after. Besides, this strong odour may be modified, and even entirely dissipated. Nothing is necessary but to glaze over the strata of varnish with a stratum of alcoholic varnish, as soon as the former is dry.

17th. Art not only prescribes a good choice in the kind of colours and in the nature of the varnish, but it authorizes, and even requires, in some particular cases, a certain œconomy in the use of the colours. Some kinds of colours are exceedingly dear, such as vermilion and oxides of copper, which lose none of their splendour, and which even experience advantageous modifications when a ground has been applied of some colour much cheaper. On such occasions, red oxide of lead (minium) is united with English red, and red sulphurated oxide of mercury, which is reserved for the last stratum. The same reason of œconomy induces painters to apply, under the green colour composed of cupreous oxides mixed with white, a first stratum of another substance destined to cover the wood or body intended to be painted. In general, the priming for a green colour is composed of yellow ochre ground in boiled oil, to which some essence has been added, and mixed up with varnish or oil. But this base, which harmonizes with the covering colour, opposes some resistance to desiccation, in consequence of its argillaceous nature. It cannot, therefore, be employed in all cases in which a green colour is required. Green with oil answers exceedingly well on yellow ochre, when destined for external objects, such as gates, shutters, palisades, railing, &c.; but for apartments the place of ochre ought to be supplied by an oxide of lead, such as ceruse, which is more drying, and which gives more body to the green colour than argillaceous matters. Besides, it is less apt to change to the tint of dark green when exposed to the light.

18th. When varnishes are very little charged with colour, as is the case when they form glazing, it is more difficult to make a regular application of them than when they are mixed with the ground. The essential point in this application, and which discovers the real artist, is to leave no marks of the brush. It must be drawn over the surface in large strokes, and with celerity; forwards and backwards are sufficient: if drawn several times over the same place, the varnish rolls under the brush. To produce uniformity in the glazing, too much varnish must not be employed at once; because it forms undulations and ridges, which break the reflection of the light, and are very disagreeable to the eye of a connoisseur. The strokes of the brush, also, must not be made to cross each other, because in this manner they cross the stratum, and the effect becomes as disagreeable as in the preceding case. For the application of glazing varnishes large flat brushes are employed; they perform the work very quickly.

19th. The mixture of essence of turpentine with all the varnishes employed for the decoration of apartments, is attended with a very strong smell, which continues several months. This odour, which is disagreeable to every body, is prejudicial to delicate persons subject to nervous affections: its effects, however, may be checked or modified in a certain degree. Painters recommend different means for this purpose; but they attach little importance to them, as they are accustomed to such emanations. In this respect every artist has a favourite process of his own.

20th. The details into which I entered in the second and third chapters on the composition of colours, and those in the present one, might be carried to a much greater length; but they are sufficient to prove that the art of varnishing has been brought to greater perfection in Europe than in China and Japan, where it originated; since the processes employed among us require a much greater share of talents and knowledge.

These people are indebted to nature alone, and not to industrious combinations, for the solidity of their compositions; and they employ only a few processes, from which they never deviate. The solid red, black, yellow, &c. lacker which comes from their manufactories is composed of no more than two substances. The nature, therefore, as well as limited number of the colouring parts they employ, proves how little extent their national industry has given to resources of this kind. Vermilion and red bole for the red colour, orpiment for yellow, and burnt bones or ivory for black, form the whole magic of the palette of the Chinese varnisher; if we add the use of gold and silver, which he distributes with much profusion and little taste, though his method of heightening the splendour of the gold announces a good deal of dexterity and long practice.

If we consider the nature of the two substances which serve as a base to their varnishes, and of which they are formed, they may be compared to our copal varnish of the fifth genus. One of these two substances is a fluid, resinous matter, which thickens in the air, and to which more body is given by a kind of oil that, in the Chinese varnishes, acts the same part as linseed oil in ours.

This first substance, or that which forms the varnish, is extracted from a tree called by the Chinese *tsi-chou*. It is a liquid resin, of a reddish colour, obtained from incisions made in these trees, which are cultivated in some of the provinces of the empire, and particularly in those of Kiang-si and Se-tchuen. There are three kinds of them; the resinous juice of which is distinguished by peculiar qualities, and which the Chinese apply to particular purposes.

The varnish, used as such, is called in China *koa-kin-tsi*. Two mordants made with the same varnish are employed: one of them admits a mixture of orpiment for certain gold colours; and the second that of cinnabar. The latter favours the application of gold under its natural colour.

The extraction of this varnish requires precautions on the part of those employed in that labour, as they are exposed to noxious exhalations, the least effect of which is to produce a dangerous kind of erysipelas. To secure themselves from these vapours, they cover the naked parts of their bodies with a kind of glue, which prevents them from coming into contact with the exhalation.

The second substance, which may be compared to our linseed oil, is called *girgili:* it is known also under the name of *tong-yeou*. With this oily matter, added to the varnish, they mix up their colours, which they extend over the polished wood. When the first strata are dry, they ornament them with various designs in different colours, which they decorate with gold or silver. They then finish their works, which exhibit more splendour and solidity than taste, and which the worst of our artists would be ashamed to imitate in regard to the design.

They employ two methods in the application of their varnish. The first, which has been described, consists in extending the colour, mixed up with varnish, over the polished wood when perfectly dry. The second requires more care. The furniture or articles to be varnished are covered with a very hard coating, formed of a sort of paste made with hemp, paper, lime, fine sand, and some other matter, which, when properly prepared, is applied to the wood. Over this paste, when very dry, and of which they compose also their figures in relief, they extend the kind of oil destined to receive the colours. This oil forms a very solid ground, on which they trace out different designs. They then spread over it two strata of varnish, and on this varnish they apply the gold, which forms the basis of their decorations. Having finished their subjects, they are glazed with a third stratum of varnish, which is polished with some soft body.

Our varnishes lose a little of their lustre when exposed to the influence of humidity; and the alteration would be still greater were they subjected to it when they come from the hands of the artist. Those of the Chinese are not affected by moisture: it even appears that a damp atmosphere is of use to them, when in the artist's hands, or when newly finished. This effect depends merely on the nature of the substances employed in these different kinds of composition.

The viscosity of the *koa-kin-tsi* requires a method of application which must be different from ours. In China all operations of art are carried on slowly: among us the contrary is the case; and there is reason to believe that this arises from necessity. In some provinces of China, as at Pekin, where the air is very dry, the varnishers are accustomed to expose their works in their manufactories, which are more subject to humidity than to dryness. Very often this condition even is not sufficient, since, according to the report of Father D'Incarville, who has given us excellent details on this subject, they spread over certain compositions wet or very damp cloths.

Our European varnishes would certainly not admit of this method. It has, however, been established in China by experience; and it will not appear extraordinary, if we only attend for a moment to the natural effect of dry air on certain gummy or viscid mixtures.

The surface of an exceedingly viscous liquid, when exposed to the influence of dry air, begins to be hardened, and the first effect of this new consistence is to check the desiccation of the part of the substance which is not subjected to the same influence: the uniformity of the texture is then interrupted. The permanent viscidity of the interior part of the varnish, and the dryness of its surface, soon occasion a shrinking in the latter, which splits or cracks. This is the effect always observed after a similar disposition. The Chinese then are obliged to maintain the surface in such a state of pliableness as may preserve harmony of consistence in the whole stratum, in order that the moisture in the interior part may have time to escape. The application of wet cloths, or establishing manufactories in situations where the air can perform the same office, appears to me to accord perfectly with the opinion which ought to be entertained respecting the particular nature of their varnish.

But, when the simplicity of the mechanical means employed by the Chinese is compared with all those processes, the aggregate of which constitutes what is here called the art of varnishing considered in all the parts which connect it with the art of making paper boxes, coach-making, painting and gilding, one will be convinced that the imitators have, in the course of a few years, far surpassed the inventors, who in a series of ages have not been able to deviate from the servile routine, which among them confines the mechanical part of the arts to uniform and invariable processes.

21st. The strongest smell, that is to say, the odour which immediately follows the application of varnish, arises from the evaporation of the essence. This emanation is charged with other vaporous principles, furnished by the different resins that enter into the composition of varnishes, or which belong to the colouring parts mixed with them. Such, in particular, is the nauseous odour of acetite of copper (verdigris). Nothing but speedy evaporation, favoured by a current of air, or a condensation of these vapours, can answer the purpose of those who wish to get rid of them.

Evaporation is speedier in summer than in autumn, seasons during which most work of this kind is performed. In summer, opening the doors and windows will produce currents of air, and soon disperse these noxious emanations. In autumn, a good fire made in the chimney will accomplish the same end, but in a slower manner.

The disagreeable and even deleterious odour may be weakened by the mixture of some balsamic substance, the odour of which is more agreeable to the organs of smelling. It may readily be conceived that this mixture will produce only a modification, which will not admit of the apartments being sooner occupied; but the odour will then exercise a different action on the organs, and be less incommodious. Musk, to persons accustomed to the smell of it, essence of cinnamon, of lemon juice, of thyme, of lavender, &c. will effect this modification. New hay will answer the purpose still better, if it be very dry; in this state it changes the odour, and at the same time it absorbs, as a mechanical mean, the vaporous emanation.

I have used for the same purpose a kind of condenser, which may be easily obtained: I here mean water, several tubs filled with which ought to be placed in the varnished apartment. The greater the surfaces presented by these tubs, the speedier will be the effect. The water by its coldness condenses the odorous vapour, which is of an oily nature; and one may sometimes observe on the surface of it a pellicle, which exhibits the prismatic colours, and which is formed by the condensed vapour of the essence. The water, in this case, performs the same office as a refrigerator in the common process of distillation. I have employed this method with complete success for apartments varnished with verdigris, and varnish made with essence. Some workmen, who call themselves painters, exclaim against the use of this condenser, under the specious pretext that it destroys the splendour of the varnish; but this fear is justified neither by reason nor by theory.

When the varnish is dry, which may be known by the hand not adhering when applied to it for a minute, and when nothing remains but the last vapours, which are always long in escaping, nitrous fumigation, so effectual in purifying foul air, may also be employed. For this purpose pour into a cup half an ounce of concentrated sulphuric acid (oil of vitriol); and having added to it half an ounce of pulverized salt of nitre, mix the whole with the shank of a tobacco-pipe, or with a glass tube. The extension of the fumes may be facilitated by carrying the cup about through the apartment. This preventive, however, may alter the beautiful reflection of the varnish, if it be delicate and not completely dry.

22d. Colours applied under varnish, as well as those destined for oil painting, require great attention to cleanliness on the part of those who employ them. The surfaces to which they are applied should be rubbed or swept, and even washed if necessary: they must, however, be well dried afterwards.

The same care must be extended to all apartments, painted or varnished. Varnish is much more disposed to be altered by dirt than oil painting; and the means employed to bring it back to its first state cannot always be the same, because the dust adheres more strongly to the resinous parts which constitute varnish, than to the surface of prepared oil.

A few strokes of a brush, with simple washing, will be sufficient for varnishes which are usually kept clean. If the dust be incrusted, soap and water must be employed by means of a sponge, taking care every time that it has been rubbed over the varnish to rinse it in clean water, and to squeeze it before it be again dipped in the soapy water.

Some employ an alkaline ley, to which they give the name of *second water*. It is called *weak second water* when it contains only a sixteenth or a twentieth of the carbonate of potash (alkali of potash); when it contains a tenth, it is *strong second water*. They even leave it an hour or two on the varnish before they rub it off with a sponge, dipped in common water. This method is attended with some inconvenience. The alkali exercises a strong action on delicate varnishes, and deprives them of their brilliancy; and if they contain red from vermilion, or blue from prussiate of iron, it alters or detaches them. But if this process be improper for cleaning varnishes, the case is not the same in regard to oil painting, and particularly gray grounds, for which it seems to be exceedingly proper. The quantity of the alkali may even be extended to an eighth of the water employed.

Some employ for the same purpose water impregnated with sulphuric acid (oil of vitriol), in such a manner that the acidity may be equal to that of strong vinegar. This water is very detergent; but it tarnishes the varnish, and the application of it must be followed by a thorough washing with pure water. This acid has the fault of forming sulphate of lime (an earthy saline matter, distinguished by the name of selenite), which incrusts the surface of the varnish, so that no washing can remove it. The friction which this operation requires necessarily alters the varnish. It is much fitter for oil painting, which is more solid and less injured by the effects of washing than delicate resinous painting. But it will be necessary to dry the surface well with soft and very warm cloths. If the muriatic acid (the marine acid) were not dearer than the sulphuric, it would answer much better for this purpose; because it forms with the dust a deliquescent salt, which washing easily removes, and which, when thus diluted with water, exercises no action on resins, nor on the most delicate colours.

But whatever may be the means employed to clean varnish or paintings by washing, they must not be left till they have been completely dried with clean and very warm cloths. Moisture is exceedingly hurtful to them; for this reason they ought to be protected from the impression of fogs. These vapours, indeed, do not possess any quality different from that of aqueous humidity; but as fogs, in consequence of their permanence, insinuate themselves more easily into all the mouldings of wainscoting, they fix there, under the form of an incrustation, all the fine dust conveyed by the air into the closest apartments, and even into those which are inhabited; and this incrustation incorporates in such a manner with the varnish that brushing is not able to remove it. If the incrustation, however, has not been suffered to remain too long, washing with water will be sufficient to detach it.

23d. During the process of applying oil colours, if any of them fall on the clothes, it may be instantly made to disappear by rubbing the cloth strongly with a bit of bread. The same effect may be produced by essence, which can be removed afterwards by pure alcohol, if the stained part be held before the fire.

24th. If any colour be left which you are desirous of preserving, nothing will be necessary but to cover it with water, and to deposit the vessel in a cool place. The brushes may be kept in the same manner, after care has been taken to free them by essence from the colour adhering to them, and to wipe them.

Alcoholic varnishes are exceedingly drying, and they possess great splendour: both these are reasons for giving them the preference. Varnishes made with essence are also brilliant; but they are less drying, and they emit a strong odour, which they retain a long time, when not covered by a stratum of alcoholic varnish. Oil painting is very durable; it is even susceptible of the brilliancy of varnish, if the colours have been mixed up with the resinous drying oil, page 120, Part I., or if it has been covered by a varnish made with essence or with alcohol; but it is slow in drying. This character, which is a sign of its solidity, is a cause of its being rejected by persons who sacrifice every thing to expedition. The time of its desiccation, however, may be very much shortened by adding to it some matter of a very drying quality; but the labour is more tedious, and painting of this kind never has the brightness and lustre of varnish. This may be sufficient to justify the preference given to varnishing; but as many persons still retain a favourable opinion of the old method of oil painting, and as it has its particular rules, it is necessary that some account of it should be given.

Oil painting.

Oil painting has a character of solidity which makes it often be preferred to that executed with varnish or in distemper. Besides, there are some circumstances, independent of taste, which imperiously require the use of it; as when it is necessary to apply a colour to external objects exposed to the influence of the weather. This kind of painting is used also for internal articles.

All kinds of oil cannot be indiscriminately used for this kind of painting, even when they form part of those which reasons, founded on experience, have indicated as alone proper for this use; such as oil of pinks, nut and linseed oil, rendered drying by particular processes.

Painting destined for external objects, exposed to the influence of the rain, solar light, &c. requires nut oil to the exclusion of every other kind, because it nourishes and develops the colour. Linseed oil, in this case, is dissipated, and destroys the colour; so that at the end of a very little time the work must be renewed.

In the case of external painting, the colours must not be ground or mixed up with nut oil to which essence of turpentine has been added; because the latter whitens the colour under the impression of the sun, in the same manner as pure linseed oil would do.

Linseed oil may be recommended in painting destined for internal articles, which are sheltered from the inclemency of the weather.

This kind of painting has its particular precepts, from which it will be proper never to deviate.

1st. When it is necessary to grind and mix up bright colours, such as whites, grays, &c. nut oil or oil of pinks is used. For dark colours, such as chesnut, brown, and olive, pure linseed oil is preferable, if the painting be destined for internal objects.

2d. Each stratum is applied cold. It is never employed in a state of ebullition, except when it may be necessary to prepare a new wall, or new and damp plaster, in order to make the paint adhere. Without this precaution, the paint rises, and falls off in scales. The first stratum on soft wood requires also a little heat, that it may penetrate better.

3d. No colour mixed up with pure oil, or oil to which a little essence has been added, ought ever to form a thread at the end of the brush.

4th. The colour must be stirred in the pot from time to time, before any of it is taken up with the brush, in order that it may preserve the same consistence and the same tone. If the ground, in consequence of metallic colours being used, does not retain the same tint, it may be brightened by pouring in a little of the same oil as that with which the colour has been mixed up.

Some painters, who are negligent in regard to the consistence proper to be given to the colour, before it is employed, think they can accomplish the required end by adding essence to the colour from time to time, when they think it too thick.

This method, in ordinary painting, is not attended with much inconvenience; but it does not answer the purpose in delicate painting. The addition of cold essence lessens the splendour of the colour; and this effect arises from the resin of the varnish beginning to be precipitated, if a varnish form the basis of the painting; and from a commencement of separation in the colouring part united to the oil, if the painting be in oil colours. In the latter case, it will be of great advantage to give the real consistence at first; and if it be found necessary to add a little more of the excipient, it ought to be warm: it requires to be well mixed before it is used.

5th. When the painting is destined for apartments, the first stratum ought to be ground in oil, and mixed up with essence. 1st. Because the latter carries off the odour of the oil. 2d. Because the colour applied over a stratum mixed up with oil, to which essence has been added, or with pure essence, becomes more brilliant, whereas it would penetrate into a stratum with pure oil. 3d. Because essence thoroughly hardens the colours mixed up with it; but if mixed with oil it makes it penetrate to the colour. When you are desirous, therefore, to varnish an oil colour, the first stratum ought to be mixed up with oil, and the last two with pure essence. When you do not intend to varnish, the first stratum ought to be mixed with pure oil, and the last two with oil to which essence has been added. Essence unites to the two advantages before mentioned a practical utility: it facilitates the extension of the colour.

6th. If the painting be intended for copper, iron, or any other hard substance, the smoothness of which opposes the adhesion of the colours by making them glide, a little essence must be added to the first strata: the essence will cause the oil to adhere. Besides, metals intended to receive varnish or colours must be polished or scoured, that is to say, roughened a little, in order that the colour may lay hold of them: this rough polishing is performed with pulverized pumice stone or tripoli, which is rubbed over the article with a piece of rag, on each stratum being applied. The article must then be exposed to the sun to facilitate the extension of it, if the varnish has a considerable degree of consistence; after which it is carried to a stove to hasten its desiccation. My turpentine copal varnish, and that even called fat varnish, dry very speedily. The operation of polishing is not performed till several strata are applied and have become dry. When such varnishes are used you may begin the polishing with pumice stone, and afterwards finish it with tripoli.

7th. If the wood contain resinous knots, which is the case in particular in fir, the colour runs in these knots, and does not adhere. If simple oil be employed, oil charged with drying matter, that is to say, litharge, mixed with a little of the ground colour, is prepared separately, and reserved for these resinous parts. If the painting be in oil, and intended to be covered with polished varnish, more litharge must be added: it masks the wood, and hardens the resinous particles which exude from it. One stratum will be sufficient, and will give body to the wood: the labour may be shortened by rubbing the place with a head of garlic.

8th. Some colours, and in particular those which have an argillaceous ground, as the Dutch pinks, boles, &c., as well as lamp-black, burnt vine twigs, &c., are long in drying when employed with oil. It will, therefore, be proper to add drying matter to them, according to the colour: litharge to dark colours, and sulphate of zinc (white vitriol) to bright colours, mixed with drying oil: this method is always attended with success. I must here observe that drying matter is unnecessary in all cases; and for all colours which admit into their composition ceruse, white oxide of lead, and other metallic oxides.

9th. If the addition of drying matter becomes necessary, it must not be added till the moment when the colour is applied, because it tends to render it thicker.

10th. One principle, which ought never to be forgotten, because it is applicable to all kinds of painting, and more particularly to the one in question, is, that a new stratum of colour ought never to be applied till the preceding is dry. It will be proper also to brush off the dust, which sometimes covers the last stratum; and which, if mixed with the new one, would not fail to alter the uniformity of its tint: this observation is applicable, above all, to bright colours, such as whites and grays. You may be sure that a stratum is dry, when it does not adhere to the hand on being applied to it.

11th. All kinds of painting require that each stratum of colour should be of an uniform thickness throughout; and as this depends on the consistence, it will be proper to maintain it in the same state. Habit and experience will be a better guide, in this respect, than any precepts that might be collected. Too thin a stratum cracks by desiccation; one too thick becomes wrinkled, acquires undulations, and interrupts the reflection of the light. The addition of a little ground colour, or of some of the vehicle, will correct one of these faults.

It will not, however, be attended with any inconvenience if a little more liquidity be given to the first stratum than to the succeeding; because it is destined rather to adhere to the substance which it covers, than to establish the tone of the required colour. But the succeeding ones, and particularly the last, ought to have sufficient consistence to prevent the shrinking of the paint; the addition of a little essence will, if it be too thick, bring it to the proper point.

12th. If a solidity capable of resisting blows and friction be required in the paint, this end will be better obtained by applying the first stratum with a metallic oxide, such as Montpellier yellow, ceruse, or vitreous oxide of lead (litharge), reduced to fine powder, ground in boiled oil, and mixed up with oil to which a little essence has been added, than by the same colour mixed up with oil.

13th. Artists, during the exercise of a profession, acquire habits, which, among persons who are desirous of placing themselves on a level with them, are converted into precepts. The amateur, after the first trial, is merely a servile imitator of the painter. In the use of the brush he does not at first show much dexterity; but being the judge of his own work, he soon discovers that he wants experience; and he at length attains, though slowly, to results which, in a skilful hand, soon improve. He feels the necessity of varying the strokes of the brush according to circumstances. Sometimes he employs long strokes, to extend the colour in an uniform manner; at other times he daubs it repeatedly over the wainscoting, to incrust the matter in the places sheltered by the mouldings or by sculpture. He avoids inequalities; he is encouraged by the new aspect which presents itself to his eyes; he perceives, and at length is convinced, that the perfection of the application concurs, in a considerable degree, towards the richness and tone of the colour, and the beautiful development it acquires from the reflection of the light. Every amateur who is fully sensible of the necessity of obtaining these results may be considered as an artist. I will even say more; he is superior to a workman without taste, whatever practice he may have had in work of this kind. The labour soon vanishes when compared with the enjoyment he procures.

But this kind of painting is attended with one circumstance, which requires the concurrence of different artists, as the labour is superior to the efforts of the amateur, however expert. I allude here to coach painting, which requires the union of the limner, the common painter, and the gilder. Besides, the application of varnish, in this case, ought to be followed by an operation which is dispensed with in all cases of varnishing or painting applied to common apartments, and to external objects: I mean polishing. This operation, which the amateur has no need to perform, shows the necessity of admitting into this species of painting a division respecting the different kinds of labour which it requires.

Division of oil painting.

Oil painting may be divided into two kinds; namely, common oil painting, and painting in oil with polished varnish. The first is simple, the other is more extensive; it forms grounds, which are polished and afterwards covered with a varnish, which is also polished. This addition of labour induces artists to admit the above-mentioned division, the necessity of which does not appear to me to be well founded. As painting in oil constitutes a separate kind, distinct from painting in varnish and painting in distemper, we can admit no other division than that which forms it into species, especially when the same matters are employed in both cases. All oil painting is susceptible of acquiring a fine polish, when the thickness of the strata admits the application of those processes which polished painting in varnish requires. It may be both varnished and glazed, to increase the brightness of the colour, and to call it forth in its full splendour. I have even given a method of fulfilling, at one operation, the conditions which establish plain painting in oil, and that in which varnish is employed. This method is that which requires the use of the drying resinous oil in page 120.

This distinction is deduced rather from that made between the objects for which this kind of painting is destined, than from the nature of the materials employed, or from the variety introduced in the composition of them. All carriages are painted in oil, then varnished, and afterwards polished. Some kinds of valuable furniture and toys made with artificial enamel require also the last-mentioned operation, which gives them a great deal of splendour, and disposes them to reflect the light in a more uniform manner.

Polishing.

The processes used in polishing are different, according to the nature of the varnish which requires it. Hard varnishes, such as those resulting from the solution of amber and copal in a drying oil, or even in essence, as well as certain oil colours, can bear the contact of hard bodies employed for polishing. It is not, however, attended with complete success but when the ground is charged with a determinate number of strata of a colour which, by painters, is called the *priming* (*teinte dure*) *. This priming gives to the

* The priming (*teinte dure*) is prepared by grinding ceruse very fine in pure oil, and mixing it up with essence of turpentine. Seven or eight strata of it are applied before it is polished. The ceruse employed for this purpose must have been subjected to a certain degree of heat, which destroys its whiteness, and prevents

whole a certain thickness and a great deal of consistence.

When the priming has received all the strata it requires, and when very dry, pumice stone finely pulverized, and sifted through a silk sieve, is mixed up with a sufficient quantity of water. Some of this powder is spread over a piece of cloth, rolled up in the form of a ball, and the ball is moved over the surface of the colour, to polish it uniformly: to determine with precision to what degree this has been effected, the polished part is frequently washed with water. When this operation is finished, two or three strata of the colour which has been chosen are applied, the motion of the brush being softened to avoid striæ; and it is then glazed with two strata of transparent and colourless varnish, should this number be thought sufficient: but if the varnish itself is to be polished in the same manner as the priming; in a word, if it be required to imitate that which covers the pannels of carriages, seven or eight strata must be applied.

When the last strata of the varnish form undulations, which cut, derange, or break the reflection of the light, it will be necessary to polish it. This last polish-

it from weakening the colours applied over it. In this state it is called by painters *calcined ceruse:* the colour of it inclines a little to yellow. It will be proper not to give too much heat to the ceruse destined for different strata of priming, because it has too much influence on the coloured grounds which it ought to support. The strata of priming are applied over a stratum formed of uncalcined ceruse, ground in linseed oil, and mixed up with equal parts of linseed oil and essence.

ing may be performed with advantage by employing tripoli, reduced to fine powder, mixed up with a little oil, and placed on a ball of serge, or, what is better, of shammy leather. The fat part may then be removed with a little bran, or with farina, rubbed over it by means of a clean linen cloth. The polishing is then completed with a bit of serge or cloth, without tripoli.

It is in this manner that the varnish which supplies the place of glazing on certain kinds of furniture, and the coloured or uncoloured varnishes applied to metallic bodies or plates of metal, are polished. The latter require only uniform friction with a piece of cloth. It is very seldom that there is any need of beginning with tripoli and oil. The finest polishing is that performed by the lathe.

Those who renew the colours on the pannels and bodies of carriages, do not amuse themselves by rubbing them with a piece of serge and pulverized pumice stone. They wear down the old colour to the wood, with a fragment of pumice stone and water. Some even employ for this operation a piece of felt and fine sand. This process is alone suited to work of this kind.

If you wish to render the colour more drying, add half an ounce of the vitreous oxide of lead (litharge) to each pound of colour. If the colour is bright, a gros of the sulphate of zinc (white vitriol) must be substituted for the litharge.

Of wax cloth. Oil cloth.

It is possible that the term wax cloth, given to some cloth prepared in a certain manner, originated from the first trials, in which wax perhaps formed a part of the composition; or it may have arisen from one of those modes of concealment, so often employed by inventors, who endeavour to take advantage of their researches, or of a happy discovery. It is, however, certain that this denomination is absolutely foreign to the articles of this manufacture, in which wax is not used.

The art of preparing these cloths is one of those which escaped the ingenious and useful undertaking of the late Academy of Sciences at Paris, entitled *Description des Arts et Métiers.* I am acquainted with no author who mentions it even indirectly. What I shall offer, in this work, will be only a sketch of the art, the processes of which, in regard to the grounds and the application of the coloured designs, are so varied and interesting as to justify and even render valuable a detailed description of them. The manufacture of these cloths, considered under a political point of view, is not unworthy the attention of the public. I shall, however, confine myself to some particular experiments, and to the knowledge I have acquired in regard to this kind of labour: it will be sufficient to prove that the preparation of oiled silks and oil-skin is connected with that of varnishes, and dependent on it.

This art originated in Holland, in consequence, no doubt, of the wants of commerce, which consumes such a large quantity of articles proper for packing goods. It is probable that the first attempts were undertaken with a view to this end, which seemed to insure to them a constant and extensive sale. It is probable also that the first processes admitted the use of wax, and that the cloth first manufactured might have a resemblance to those packing-cloths which come from India, and which are covered with a waxy substance.

The name of wax cloth, which was then proper for them, surviving the composition, may have served to denote, till the present time, finer compositions, executed with greater care, and yet less expensive; as wax is of more value than the substances now used in preparing these cloths, which are employed for so many useful purposes.

If Holland was the birth-place of this kind of manufacture on a large scale, it is possible that the first processes may have been known and followed in neighbouring countries. This much, at any rate, is certain, that the extent since given to the manufacture, by admitting a certain finish in the designs, must contribute to multiply the enterprises. There are indeed excellent manufactories of this kind in the ci-devant Austrian Netherlands, in Germany, and particularly at Franckfort, where the workshops altogether occupy a very considerable extent.

Every manufacturer and every workman has his own compositions and methods, which he applies to the kind of work intrusted to him. The process for common varnished cloths is very simple; but, as I have already said, there are others which require more intelligence on the part of the workman, as the same care is necessary as for painted cloths. In these varnished cloths the art of the colourist is put to the test; because the finishing, the happy mixture of the colours, the richness of their variety, the natural appearance of the shades, and the delicacy of the strokes, concur to enhance their value, and consequently to secure to them a speedy sale.

But if the difference of the labour has so powerful an influence on this kind of manufacture, it may readily be conceived that the quality of the cloth must contribute towards the same end; for it is this quality alone which determines the kind of painting that ought to be employed. Varnished cloths, therefore, of different degrees of fineness are manufactured.

Common wax cloth or varnished cloth.

The manufacture of this kind of cloth is very simple, and may be carried on at very little expense. The cloth and linseed oil are the principal articles required for the establishment.

Common canvas, of an open and coarse texture, is extended on large frames, placed under sheds, the sides of which are open, so as to afford a free passage to the external air. The manner in which the cloth is fastened to these frames is very simple and convenient; for when it becomes slackened, during the application of the varnish paste, it can be again tightened. It is fixed to each side of the frame by a kind of hooks which catch the edge of the cloth, and by pieces of strong packthread passing through holes at the other extremity of the hooks, which are tied round moveable pegs placed in the lower edge of the frame. The mechanism by which the strings of a violin are stretched or unstretched, will give some idea of the arrangement of the pegs employed for extending the cloth in this apparatus. By these means the cloth can be easily stretched or relaxed, when the oily varnish has exercised an action on its texture in the course of the operation. The whole being thus arranged, a liquid paste made with drying oil, which may be varied at pleasure, is applied to the cloth.

Liquid paste with drying oil.

Mix Spanish white or tobacco pipe clay, or any other argillaceous matter, with water, and leave it at rest some hours, which will be sufficient to separate the argillaceous parts and to produce a sediment. Stir the sediment with a broom, to complete the division of the earth; and after it has rested some seconds decant the turbid water into an earthen or wooden vessel. By this process the earth will be separated from the sand and other foreign bodies, which are precipitated, and which must be thrown away. If the earth has been washed by the same process, on a large scale, it is divided by kneading it. The supernatant water is thrown aside, and the sediment is placed in sieves, on pieces of cloth, where it is suffered to drain: it is then mixed up with oil rendered drying by a large dose of litharge, that is to say, about a fourth of the weight of the oil. The consistence of thin paste being given to the mixture, it is spread over the cloth by means of an iron spatula, the length of which is equal to that of the breadth of the cloth. This spatula performs the part of a knife, and pushes forwards the excess of matter above the quantity sufficient to cover the cloth.

Though the earth mixed in this manner still contains water, it readily unites with the boiled oil. The water passes into the tissue of the cloth, which facilitates its evaporation; and the cloth at the same time acquires the property of not suffering itself to be too much penetrated by the oily varnish. However liquid the varnish may be, it does not transude to the inferior surface of the cloth.

When the first stratum is dry a second is applied. The inequalities produced by the coarseness of the cloth, or by an unequal extension of the paste, are smoothed down with pumice stone. The pumice stone is reduced to powder, and rubbed over the cloth with a piece of soft serge or cork dipped in water. A whole pumice stone, one of the faces of which has been ground smooth, may also be employed. The cloth must then be well washed in water to clean it; and, after being suffered to dry, a varnish of gum lac dissolved in linseed oil boiled with turpentine, and which is liquefied with essence of turpentine, if necessary, is then applied to it.

This preparation produces yellowish varnished cloth. When you are desirous of rendering it black, nothing will be necessary but to mix lamp black with the Spanish white, or tobacco-pipe clay, which forms the basis of the liquid paste. Various shades of gray may be obtained, according to the quantity of the lamp black which is added. Umber, Cologne earth, and different ochrey argillaceous earths, the nature of which has been explained in the chapter on colours, may be used to vary the tints, without causing any adddition to the expense.

Fine printed varnished cloths.

The process just described for manufacturing common varnished and polished cloths may serve to give some idea of that employed for making fine cloths of the same kind, decorated with a coloured impression. At first this kind of manufacture was confined to common cloths, with a smooth ground of different colours. Industry, however, has given it greater extent, by finding on the palette of the painter all those materials capable of making this new art rival that of printed cloths. The firmness of the texture of the cloth, still increased by that of a pliable covering impermeable to water, opened for this kind of manufacture a very lucrative sale, in consequence of a more careful application of the colours, which could be subjected to all the rules of design. The manufactories of Germany, indeed, have varnished cloths embellished with large and small subjects, figures, and landskips, well executed, and which being destined for covering furniture subjected to daily use, gave certain support to this branch of industry.

This new process, which is only an improvement of the former, requires a finer paste, and cloth of a more delicate texture. The stratum of paste is applied in the same manner; and when dry and polished, the cloth is taken from the frame and removed to the painter's table, where the art of the colourist and designer is displayed under a thousand forms; and, as in that of printed cottons, exhibits a richness of tints, and a distribution of subjects which discover taste, and ensure a ready sale for the articles manufactured.

The processes, however, employed in these two arts to extract the colouring parts are not the same. In the art of cotton-printing the colours are extracted by the bath, as in that of dyeing. In printing varnished cloths, the colouring parts are the result of the union of drying oil mixed with varnish, and the different colours employed in oil painting or painting in varnish.

The varnish applied to common oil cloth is composed of gum lac and drying linseed oil; but that destined for printed varnished cloths requires some choice, both in regard to the oil and to the resinous matter which gives it consistence. Prepared oil of pinks and copal form a varnish very little coloured, pliable, and solid.

Varnished silk.

There are two kinds of varnished silk; one employed for making umbrellas, capots, coverings for hats, &c.; and the other known under the name of sticking plaster, or court plaster.

The first is prepared in the same manner as the varnished and polished cloths already described, but with some variation in the choice of the matters employed to make the liquid paste or varnish with which the silk is covered. The basis of the second is a gelatinous stratum, which is afterwards covered with a varnish of the first genus: that is say, an alcoholic varnish exceedingly simple in its composition.

For the preparation of the former, if the surface of the silk be pretty large, it is made fast to a wooden frame furnished with hooks and moveable pegs, such as that used in the manufacture of common varnished cloths. A certain quantity of a soft paste, composed of linseed oil boiled with a fourth part of litharge, white of Troyes, Spanish white or tobacco pipe clay, lamp black and litharge, is then prepared in nearly the following proportions: tobacco pipe clay, dried and sifted through a silk sieve, 16 parts; litharge ground on porphyry with water, dried and sifted in the same manner, 8 parts; lamp black, 1 part. This paste is then spread in an uniform manner over the surface of the silk, by means of a long knife having a handle at each extremity.

In summer twenty-four hours are sufficient for its desiccation. When dry, the knots produced by the inequalities of the silk are smoothed with pumice stone. This operation is performed with water; and when finished the surface of the silk is washed. It is then suffered to dry, and the copal varnish of the fifth genus No. 28. is applied.

If it be intended to polish this varnish, it will be proper to apply a second stratum; after which it is polished with a ball of cloth and very fine tripoli, or with a piece of strong cloth only. The varnished silk which results from this process is very black, exceedingly pliable, and has a fine polish. It may be rumpled a thousand ways without retaining any fold, or the mark of a fold. It is light; and this quality renders it proper for coverings to hats, and for making cloaks and caps, so useful to travellers in the time of rain.

When manufacturers wish to turn to advantage old remnants of silk, whatever may be their colour, which do not exceed half a yard in length, they think it sufficient to fasten them to frames of the same size with a piece of packthread, keeping them as much stretched as possible. The liquid paste is then poured over the silk in small portions, and spread out by means of a common knife with a round point, somewhat like that of a table-knife, to prevent the cloth from being cut. The handle of the knife stands at right angles to the blade, so that all the movements required for extending the paste can be made without the fingers touching the silk, and without removing the blade from an exact horizontal position: a little practice will enable the workman to render the surface of the silk as smooth in this case as in that where a large blade is employed in the operations on a more extended scale.

In the last place, if the silk consists of long narrow bands, the mechanism which I employed for making two or three yards of plaster at once may be used.

Provide a common smooth table, eighteen or twenty inches square, and placed perfectly horizontal. At the two extremities of this table let there be fixed two iron screws in a perpendicular direction, which pass through two rings at the extremities of an iron rule or blade which stands in a vertical position, and which can be moved nearer to or further from the table by means of two nuts fitted to the screws. But to determine the thickness of the stratum of the composition to be spread over the cloth, there are placed close to the screws, and between the rule and the table, as many squares cut from a common card as may be necessary to give the thickness required; two or three will be sufficient.

When this arrangement has been made, place one of the ends of the cloth between the rule and the table, in such a manner that it may pass beyond the former about an inch, that you may be able to draw it towards you during the operation; then pour the composition on the cloth near the interior side of the rule in such a manner as to cover the cloth throughout its whole breadth. Care must be taken to make the matter continue running, while another person draws the cloth towards him till the whole of it has been subjected to the pressure of the rule. By this mechanism the stratum will have an uniform thickness, and will be so even as to have no need of being smoothed with pumice stone. When the stratum is dry, cover it with the copal varnish No. 23.

It was with a similar composition and by an analogous process that an artist of Geneva, named Louvrier, prepared his pliable varnished silk, specimens of which he presented to the society of arts: the same paste also, covered with a varnish, he applied to linen, felt, leather, &c.; and the use of it might be rendered more beneficial and extensive by applying it to boots, half-boots, and shoes, which might in this manner be rendered impermeable to water.

Another kind of varnished silk.

A kind of varnished silk, which has only a yellowish colour, and which suffers the texture of the stuff to appear, has been some time in use. The matter employed in the preparation of it is a plain varnish. The silk is covered with a mixture of three parts boiled oil of pinks, and one part of fat copal varnish, which is extended with a coarse brush or with a knife. Two strata are sufficient when the oil has been freed from its greasy principles over a slow fire, or when it has been boiled with a fourth part of its weight of vitreous oxide of lead (litharge).

The inequalities are removed by pumice stone and water; after which the copal varnish is applied. This simple operation gives to white silk a yellow colour, which arises from the boiled oil and the varnish.

This varnished silk possesses all those qualities ascribed to certain preparations of silk which are recommended to be worn as jackets by persons subject to the rheumatism. Some physicians have placed great confidence in flannel dyed with indigo: it would be very easy to introduce this colour into the varnish destined for this preparation.

Sticking plaster. Court plaster.

The preparation of sticking plaster or court plaster is still simpler: the basis of the first stratum is glue.

Bruise a sufficient quantity of fish glue, and let it soak for twenty-four hours in a little warm water: expose it to heat over the fire to dissipate the greater part of the water, and supply its place by colourless brandy, which will seize on the gelatin (glue). Strain the whole through a piece of open linen, and take care that the quantity of the excipient be such that on cooling it shall form a trembling jelly.

Extend a piece of black silk on a wooden frame, and fix it in that position by means of tacks or packthread. Then with a brush made of badger's hair apply the glue, after it has been exposed to a gentle heat to render it liquid. When this stratum is dry, which will soon be the case, apply a second, and then a third if you are desirous of giving the plaster a certain thickness. As soon as the whole is dry, cover it with two or three strata of a strong tincture of balsam of Peru.

This is the real English court plaster: it is pliable and never breaks; characters which distinguish it from so many other preparations sold under the same name.

This article has been adulterated as well as many others. A kind of plaster, the covering of which is very thick and brittle, is often sold under the same name. The fabricators of this article instead of fish glue, which is dear, employ strong common glue, the strata of which they cover with an alcoholic varnish like those of the first genus. This plaster cracks, and never has the balsamic odour by which the real English court plaster is particularly characterized. To detect this fraud nothing will be necessary but to rub it a little.

When you wish to use the English plaster, moisten it with saliva on the side opposite to that which is varnished, and it will adhere exceedingly well. The adulterated plaster is too hard to adhere by so simple a preparation; it requires to be moistened on the varnished side.

The use of this plaster ought to be confined to cuts alone; and should never be extended to scratches or wounds accompanied with contusion, though this restriction seems contrary to the pompous directions for using it which are published. In the two latter cases the application of any gummy plaster, however well prepared, is always attended with inflammation, which must afterwards be treated with cataplasms of bread and milk.

Having said every thing necessary in regard to painting in oil with or without varnish, comprehending that branch which relates to varnished cloth and silk called improperly wax cloth, it now remains that I should describe the last kind of painting, called painting in distemper:—It forms the subject of the following chapter.

CHAPTER V.

Of painting in distemper. Sizing. Composition of colours for distemper. General precepts in regard to this branch of the art.

The use of distemper is older than that of painting in oil or in varnish. It is needless to adduce any testimonies to prove this assertion, for we may assign to this art the same origin as that of white-washing. White-washing applied with art is a kind of distemper when the builder, induced by a desire of giving it solidity, introduces into it glue, which is one of its principles, whatever be the matters over which it is extended. The polishing which is given to this kind of work by several washings has an affinity to distemper which the French call *Badigeon*.

The first attempts in distemper must have been very imperfect; but being susceptible of assistance from the different colouring parts which contribute so easily towards the magic effects of painting, this branch of house-painting must have participated in the general improvement resulting from the continued efforts of human industry: it must have deviated from its first rules of simplicity to rise to a degree of perfection. It soon, indeed, became the basis of the painting with coloured grounds on which the first trials were made of glazed varnishes, and under the names of *chipolin* and *blanc de roi* was employed as one of the most elegant and most esteemed decorations for embellishing palaces in all cases where it was ornamented with figures.

In every kind of distemper glue, a gelatinous matter extracted from different parts of animals, of whatever sort it might be, became the principle of the solidity observed in this branch of painting. It serves as a bond to the divided parts, which are united by a pulverulent adhesion of mere contact: in the last place, it prevents them from being detached when rubbed with a brush.

The varnisher does not confine the use of glue to painting in distemper: he destines it also for covering and preserving the paint with which certain articles intended to be varnished are covered; such as paper or other substances painted in gum; boxes, fans, &c. But the kind of articles to which size is applied prescribes a choice in the matters proper for furnishing the glue. For delicate objects pure glue incapable of communicating any foreign tint is required. Fish glue or that obtained from remnants of parchment will answer these conditions. Glovers' clippings and those of white leather give a glue sufficiently pure for common distemper. The glue extracted from the clippings of sheep's and goats' skins may be used in the common kind of distemper. In the latter cases the work may be considerably shortened by dissolving common strong Flanders glue in a certain quantity of water. This glue is the dry extract obtained from the ligaments, cartilages, tendons, interior membranes, and clippings of the skins of animals, which have been subjected to strong boiling.

All these substances give a gelatin (glue) weaker or stronger, according to the age of the animal and the part from which it has been extracted. That obtained from the skin is the strongest. Flanders glue, however, is employed in general for all articles to which distemper is applied on a large scale; because in works of this kind transparency is required rather than strength.

GLUE OF THE FIRST QUALITY.

Fish glue.

Whatever be the matter from which it is proposed to extract the gelatin (glue), the process always employed is strong decoction in water. Fish glue holds the first rank among the substances of this kind on account of its being colourless. The preparation of it is very simple. The twisted pieces of the membranous matter which furnishes it is bruised by means of a mallet, and then torn to shreds, which are cut into small portions and boiled in a sufficient quantity of pure water. The decoction being strained through a clean cloth which retains the membranous part, it is evaporated over a slow fire until it be observed that some drops of the decoction thrown on paper and deposited in a cool place assume the consistence of a trembling jelly. The decoction is then left to cool. In this state it will keep five or six days in summer, and longer in winter.

Sometimes brandy is employed for diluting this glue; but as the temperature to which it is exposed dissipates all the spirituous matter, it will be better to add brandy to fish glue already prepared and of a consistence somewhat strong. The addition of the brandy contributes towards its longer preservation, and accelerates its desiccation when employed, but it lessens the limpidity of the liquid.

This consistence would prevent it from being freely extended over the works which are to be sized, were it not diluted at the time of its being employed with a little warm water. It is in the latter state of liquidity that it is applied to articles which can stand the required degree of heat, such as wood, fans, &c. But when it is apprehended that this temperature may produce bad effects on the colours or on the cut paper figures, for cementing which it may be employed, it is then diluted with cold water and it is kept liquid at the temperature of the atmosphere.

Certain delicate works require only a slight concentration in the solution of glue. For example, if it be required to fix crayons, by Loriot's process, six or eight deniers, or from 150 to 200 grains of fish glue, rendered soluble in 16 ounces of pure water, which is still diluted with two parts of alcohol at the time of its application, will be sufficient to give the proper degree of strength to such works, and to prevent the powder from being detached. The evaporation is very much favoured by the alcohol (spirit of wine).

GLUE OF THE SECOND QUALITY.

Glue made from glovers' clippings or from parchment.

Put to soak in warm water for twelve or fifteen hours clippings of parchment, and then boil them for five or six hours: strain the whole through a piece of open linen or through a hair sieve to separate the membranous portions deprived of their gelatin. Leave the decoction at rest and it will soon condense into a jelly. If the decoction be made in summer, the temperature which keeps the glue long in a state of liquidity gives it time to clarify. The upper part, indeed, has the appearance of trembling jelly, exceedingly clear and without colour. When the clippings of parchment have been well chosen, the whole of the clear part of the glue, in consequence of its consistence, may be separated by means of a skimmer from that at the bottom of the vessel, the transparence of which is often disturbed by bodies that are foreign to pure gelatin.

This glue may be employed in all cases where great cleanness is required; and therefore may be substituted for fish glue. It is in this state that it ought to be used for sizing, and for that beautiful kind of distemper called *chipolin* or *blanc de roi* (royal white).

GLUE OF THE THIRD QUALITY.

Common glue.

Painting in distemper will admit, in many cases, a kind of glue inferior to those of the first two qualities. All objects comprehended in the distemper applied to ceilings, walls, &c., do not require much nicety in the choice of the matters proper for furnishing the glue. Under these circumstances solidity is more attended to than neatness. Common Flanders glue dissolved in water is very often used instead of that of a finer quality.

When this glue is to be prerared, take clippings of sheep's skin, goats' skin, and of parchment, and boil them for three or four hours in a sufficient quantity of water (seven or eight parts in weight for one of matter). When the decoction is reduced to a-third, strain it through a hair sieve or piece of linen: on cooling it assumes the consistence of a strong jelly, which may be weakened according to circumstances. In consequence of the consistence here mentioned this glue is distinguished by the name of strong glue, a technical term often employed in the formulæ of different compositions, and which cannot be applied to the strong dry glue sold in the shops. The addition of two pounds of water will form a mean kind of glue; and eight pounds of water to the same quantity will give simply glue: it may still be rendered weaker should circumstances require it.

Glue of this kind must be employed immediately; because it will not keep more than five or six days in summer, even in a cool place. If the weather is tempestuous, it will soon corrupt: when it loses its consistence and dissolves into water it has reached the first term of alteration, and soon passes to the state of putrefaction. When this change in the consistence of glue is observed it can no longer be used in distemper.

These different kinds of glue, which differ from each other only by the greater or less degree of their purity and colour, may be applied to different kinds of works, according to their fineness. The first kind is destined to defend delicate painting, coloured paper, paintings in water-colours, &c., from the attacks of varnish. That of the second quality may be used, with the precautions already mentioned, for the same purposes. That of the third is employed for common sizing.

Sizing.

The word sizing denotes that operation by which a solution of glue is spread over articles intended to be painted in distemper or to be varnished. Size is applied cold. This stratum of glue fills up the pores of the wood, paper, &c., and deposits in them a matter impenetrable to alcohol and to the essential oils, which serve as excipients to the resins employed in the composition of varnishes. If several successive strata of it be applied it may even serve as a varnish itself; but being by its nature soluble in water, the least impression of humidity, that of the moist hands, and the adhesion of dust, which is the consequence, would soon tarnish the objects to which it is applied and destroy their neatness and brilliancy, which are their most valuable qualities.

Varnish, therefore, may be applied to this first stratum without injuring the colours and without penetrating further; and if the strata be multiplied, so as to give to the whole a sufficient thickness, it will bear the operation of polishing.

The varnishes applied in distemper call forth the colours with new lustre. This remark, however, cannot be generalized without inconvenience, because every kind of distemper does not produce, under varnish, the same result. Distemper, the basis of which is chalk, does not possess this property in its whole extent; it becomes brown under the first stratum of varnish. This application of varnish to distemper requires then a choice in the bases, or in the colouring matters, which constitute distemper in size. Clay supports varnish better than chalk; it also shrinks less; but the colours taken from metallic substances are those which in distemper harmonize best with the splendor of varnish: of this kind are ceruse, white lead ground and mixed up with essence for the first stratum.

If I have here specified cases which require that size should be applied cold, there are others which require that the jelly employed for sizing should have a certain strength; that it should be thick, and consequently that it should be employed warm; the last stratum excepted, which must consist of weaker glue, if intended to be covered with varnish.

The substances fit to be painted in distemper are wood, walls, plaster, skins, cloth, pasteboard, paper. But before I give examples in these three kinds of distemper, it will be proper to lay before the reader the precepts which belong to this kind of painting.

General precepts applicable to painting in distemper.

Distemper is often employed with a view of covering it with painting which exhibits some particular subject.

In this case it will be necessary, 1st, That the ground to which the distemper is to be applied should contain neither grease nor lime; 2d, That it should be covered with some preparation to render the surface very smooth. This preparation is generally made of white, because it heightens better the colours, which always borrow something from the ground; 3d, That the consistence of the colour should be such that it may run or drop from the brush in a thread when taken from the pot. This condition is contrary to that established, in a similar case, in regard to painting in oil and in varnish. If the colour does not form a thread, it is too thick, and the work will be in danger of becoming scaly; 4th, That all the strata, the last excepted, must be applied warm, taking care, however, that the matter does not boil; for when too hot it injures the first strata and spoils the subject; and if applied to wood it may cause it to split. Besides, a solution of glue exposed to too high a temperature assumes a fat character, and loses its tenacity. These four conditions, according to artists, form the principal laws of this kind of painting.

I shall, however, add a fifth; which is, that if the strata are to be multiplied they ought all to be of an equal thickness. This equality depends on the strength of the glue and the quantity of the matter applied: if the strata vary in this respect the painting rises up in scales.

If the ground to which the distemper is applied contains grease or lime, this inconvenience may be removed by scraping, in case it be a wall; or by a solution of the carbonate of potash (alkali of potash) if it be wood; canvas must be cleaned by means of a ley.

If the walls destined to receive any subject in painting be very smooth, a stratum of warm glue is applied which penetrates into them and disposes the surface of the stone or plaster to incorporate with the colours. But if they are rough, a coating of Spanish white or chalk mixed with a solution of glue is employed to render the surface smoother. When this coating is dry, it is scraped as clean and as equally as possible. It may readily be conceived that this operation is applicable only to small inequalities; for if they were considerable or accompanied with holes, it would be necessary to equalize the surface with gypsum and to allow the latter sufficient time to assume body, which will not be the case till it be thoroughly dry.

The improvement made in common distemper, the origin of which is as old as the use of *badigeon*, as mentioned in the commencement of this chapter, having very much extended its utility and diversified the cases of its application, it is necessary to establish in this branch of the art relative distinctions. These distinctions seem to be justified not only by the modifications which it has been indispensably necessary to admit into the processes, which must be varied according to circumstances, but even by the precautions, the address, and the experience which this kind of painting requires on the part of the artist, the success of whose operation depends entirely on himself.

Painting in distemper then is distinguished into three kinds; 1st, Common distemper; 2d, Varnished distemper, known by the technical term of *chipolin*; 3d, *Blanc de roi*, or royal white.

FIRST KIND OF DISTEMPER.

Example I.

If plain distemper is to be applied to a wall or partition covered with plaster, some Spanish white or white of Troyes is thrown into water, where it may be easily broken and diluted if allowed sufficient time to soak: the water must be charged with it to saturation. A little charcoal black, diluted separately in some water, is then added, to correct the too great whiteness, and to prevent it from becoming yellow. To the water saturated with white one half of a solution of strong glue in water is added, exceedingly hot, but without being in a state of ebullition, and it is then applied with a brush. The coatings or strata are repeated till it is observed that the tint has become uniform. This operation is simple and merely mechanical; yet it is not an easy matter for the artist to give an uniform tone to all the parts of the work, when the surfaces to be covered are so extensive as to render it necessary to have recourse to new mixtures. One of the great inconveniences of this kind of painting is, that the effect of it cannot be seen till it is dry. Care must therefore be taken to try each mixture on pieces of prepared wood, having the same tint as the ground, that the real tint may be obtained.

It sometimes happens also, that when painting in distemper is applied to surfaces which have been already painted, the colour refuses to adhere, and exhibits the same phænomenon as if water were presented to oil.

In this circumstance there are two cases. The first is explained by the dryness of the preceding stratum; an effect arising from the chalk. It rarely occurs with Spanish white, and never with ceruse or white lead. The difference in the strength of the solution of strong glue, employed for the two strata, is a second cause of this result.

If the sizing of the first stratum be stronger than that of the second, there is only one method of obviating the inconvenience which takes place; namely, the addition of a little ox gall in the new stratum. I have produced the same effect by an alkaline liquor of potash; for if the glue be too strong, too abundant, or too much heated, it assumes an unctuous character which the chalk is not able to modify. Spanish white, or that of Bougival or Morat, will ensure success, in consequence of their argillaceous nature.

Distemper, if intended to serve as a ground for any subjects painted in fresco or in oil colours, requires another preparation, formed of a more solid substance, which may give more hold to the colours it is to receive. Ceruse will answer this purpose better than Spanish white, which however is superior to white of Troyes. This application will remove every restraint in regard to the kind of painting; it may be in gum, in fine distemper, or in oil: this is an advantage which cannot be expected from an earthy substance.

By this attention, in regard to the choice of the matters which are to serve as the ground, the paintings with which apartments are decorated will always produce their effect, to whatever light they may be exposed; the greater the light, the livelier and more beautiful they appear. They participate with crayon-painting in the property of not being subject to those reflections of the light which prevent the beauty of a painting from being seen, except under a certain point of view, and in a determinate direction of the luminous rays.

This method holds the first rank among the common kinds of distemper; but there are many cases which do not require either the same precision or very long details. There has lately appeared in the *Décade Philosophique* a new process, described by Cadet-de-Vaux, which this author substitutes for that of painting in distemper. Though I have not tried it, the confidence which I place in the exactness of a person so well known for his knowledge and zeal in regard to every object of public utility, induces me to introduce into this work the formula of his composition.

In regard to those kinds of distemper employed for some particular articles in the interior part of houses, I shall content myself with extracting from Watin's work such examples as may be useful in our method of building.

Example II.

Painting in milk.

Take Skimmed milk 4 pounds.
Lime, newly slaked, 6 ounces.
Oil of pinks, or linseed, or nut oil, 4 ounces.
Spanish white 3 pounds.

Put the lime into an earthen vessel or into a clean bucket, and having poured over it a sufficient quantity of milk, add gradually the oil, stirring the mixture with a wooden spatula; then pour in the remainder of the milk and dilute the Spanish white.

Milk skimmed in summer is often found to be curdled; but this is of no consequence for the present purpose. The contact of the lime soon restores its fluidity; but it must not be sour, because in that case it would form with the lime an earthy salt, susceptible of attracting the humidity of the atmosphere.

The lime is slaked by immersing it in water, from which it is taken that it may be suffered to effloresce in the air.

The choice of the oil is a matter of indifférence: any of the three above mentioned may be employed; but for a white colour that of pinks ought to be preferred. The mixture of the oil with the lime forms a kind of calcareous soap; and in this state the oil is susceptible of an union with the whole of the ingredients.

The Spanish white is pounded and carefully strewed over the surface of the liquid. It gradually becomes impregnated with it, and falls to the bottom. This process is applicable to every kind of distemper made with chalk or with white argillaceous earths. When the white has fallen to the bottom it is stirred with a stick. This painting may be coloured, like every other in distemper, by means of the different colouring substances employed in common painting. The above quantity will be sufficient to give a first stratum to a surface of 24 square yards.

The author, in his memoir, explains the advantages of this kind of painting; they are such that no doubt can remain, in regard to its superiority, when compared with the results of painting in distemper with size. It is stronger, and does not, like the latter, detach itself in scales. The gluten which composes it is not susceptible of decomposition, like the glue or animal gelatin which gives body to common distemper. The latter becomes speedily decomposed, and passes to the acid state by the effect of the humidity which it attracts and retains. As the colouring body is not then bound by any gluten, it assumes the form of dust, which is detached by the least friction.

Besides, this preparation is less expensive, and particularly in countries where milk is abundant. It is also attended with less trouble, especially as the best glues from the clippings of skin spass so readily to the acid state, and lose their strength, independently of the bad odour which they emit in this state of decomposition, and of the dampness which they maintain in the walls.

This painting in distemper dries in an hour, and the oil which forms part of it loses its odour in passing to the saponaceous state by its combination with the lime.

One stratum will be sufficient for places which are already covered with any colour, if the latter does not penetrate through it, and produce spots; two strata on new wood; one stratum on staircases and on ceilings.

The author does not confine this composition to distemper alone: he applies it also to painting in oil, which he calls *resinous painting in milk*, and which he employs for external objects. As this composition forms neither common distemper nor oil painting, I thought it improper to separate them.

Resinous painting in milk.

For painting external objects, add to the preceding composition for painting in milk:

Slaked lime, - -	of each 2 ounces.
Oil, - - - - -	
White Burgundy pitch,	

Put the pitch into the oil which is to be added to the liquid milk and lime, and dissolve it in a gentle heat. In cold weather the milk and lime must be warmed, to prevent too sudden a cooling of the pitch, and to facilitate its division in the milk and lime.

It appears to me that time alone can determine whether this kind of painting be as durable as oil.

painting; for the shrinking, to which certain strata of painting on wood are subject, depends in a great measure on the nature of the wood. At Geneva, the fir wood employed for constructing works exposed to the influence of the air is not equally proper for painting in oil. That of Savoy is porous, splits in the air, and is more subject than any other kind to be eaten by worms. The stratum of painting applied to it detaches itself in scaly leaves. The Burgundy fir is more compact and more resinous, and the resin it contains, by forming a ground to the painting, contributes to its solidity and preservation. It is always smooth and firm, and has not the inconvenience of yielding to the influence of dryness and moisture, which is always less observed in wood of this kind than in that which is exceedingly porous. The latter kind of painting may be substituted for *badigeon*, which will be described as the fourth example of painting in distemper.

Example III.

Painting for the fire-places and hearths in kitchens, &c. The Genevese method.

The Genevese employ a kind of stone, known under the name of *molasse*, for constructing fire-places and stoves, after the German manner. This stone is brought from Saura, a village of Savoy, at no great distance from Geneva: it has a grayish colour, inclining to blue, which is very agreeable to the eye. This tint is similar to that communicated to common whitewashing with lime, chalk, or gypsum, the dullness of which is corrected by a particle of blue extract of indigo, or by charcoal black.

Very fine beds of pretty pure clay, the colour of which is exactly similar to that of the molasse of Sura, has been discovered at Yvoire, another village in Savoy: it is employed by the servant maids to scour out or conceal the spots of grease or of charcoal which sometimes stain the hearths or chimney-pieces in kitchens. They keep by them some of this clay mixed up with a little water, and apply it with a brush destined for that use after the stains have been rubbed with a fragment of the same stone. This is a kind of plain distemper without size.

Some whitewashers have lately conceived the excellent idea of employing this clay in their distemper for articles much exposed to be dirtied; such as kitchens, workshops, &c. They treat it with a solution of glue, as in the first example. The tone of its colour, which is always uniform, presents one advantage not found in artificial mixtures, the true tone of which cannot be known till the stratum is dry. In this case, therefore, the operator proceeds with more certainty, and avoids those repeated trials which are inevitably necessary to obtain an uniformity of tint when new mixtures must be made to complete the work. Besides, servant maids, by the daily use of this clay mixed up with water, are enabled to wipe out stains and repair other accidents which may alter the uniformity of a stratum of this distemper.

Clay of a bright gray colour is very common. It is even so rich in variety of shades, that it may be of great use in families who wish to imitate this part of the cleanliness of the Swiss. The advantage they might derive from it would not be confined merely to gratification of the eye. The first step towards an improvement in the convenience of domestic life soon leads to attempts towards other objects; and it is in this manner that people, without any direct design, and even without perceiving it, remove from their habitations every thing that might alter the salubrity of them. The beneficial effects which result from continued care, in regard to every thing that tends to promote cleanliness, are too apparent not to be observed and to be justly appreciated. Diseases which become epidemical in certain districts in our neighbourhood, and which often occasion great ravage, seldom appear among us with the same malignant characters. Cleanliness, I may even say minute attention to cleanliness, both of furniture and persons, together with sobriety, is the best preserver of health. This observation is not foreign to a subject which treats on the best method of giving elegant simplicity to the interior of houses.

Example IV.

Distemper for parquets or floors of inlaid work.

The use of *parquets*, properly so called, or those combinations of oak and walnut-tree which produce so good an effect, is not very common in Swisserland, and those which exist admit only of waxing. The name of *parquets* is given to boards of fir intersected by pieces of walnut-tree; or disposed in compartments of which the walnut-tree forms the frame or border*; but to such works no other lustre is communicated than that which they receive from wax, and from being frequently cleaned. Some floors have been executed of plaster, on which the lemon yellow colour destined for *parquets* of oak produces a very good effect.

To obtain this colour, boil in 16 pounds of water half a pound of yellow berries, and as much terra merita and bastard saffron; add to the mixture four ounces of sulphate of alumine (alum), or carbonate of potash, which is preferable; and having strained the whole through a silk sieve, add to the strained liquor four pounds of water charged with a pound of Flanders glue.

Apply two strata of this colour with a brush, and when dry wax it, and polish the surface with a rubber.

In this preparation nothing is sought for in the bastard saffron but the colouring part soluble in water: that which is soluble in the alkali passes partly into the bath, if carbonate of soda (potash) has been employed. But as the addition of an acid would be necessary to make the latter appear, its effect in this case is scarcely perceived: it contributes, however, to the solidity of the tint.

Example V.

Red for corridors and halls paved with tiles.

A brush dipped in the water which comes from a common ley, or in soapy water, or in water charged

* Some of the floors in France and other countries on the continent are constructed in this manner.—T.

with a twentieth part of the carbonate of potash (alkali of potash), is in general drawn over the tiles. This washing thoroughly cleans them, carries off the greasy spots, and disposes all the parts of the pavement to receive the distemper. They are then left to dry.

On the other hand, dissolve in eight pounds of water half a pound of Flanders glue, and while the mixture is still in a state of ebullition, add two pounds of red ochre, mixing the whole with great care. Then apply a stratum of this mixture to the pavement, and suffer it to dry. A second stratum is applied with Prussian red, mixed up with drying linseed oil, and a third with the same red, mixed up with size. When the whole is dry rub it with wax.

Such is the method generally employed; and this succession of strata is attended with peculiar advantages. The first ley, penetrating into the tiles, forms a ground of adhesion to the second; and the last receives from the second a great deal of solidity, and prevents the slowness of the desiccation of the stratum with oil, which would adhere to the feet or be rubbed off by the scrubber, were it not entirely dry. The third stratum may be dispensed with, if pulverized litharge be mixed with the colour, which will then become more drying.

I have shortened the operation very much by reddening the new tiles with a preparation composed of the serous and colouring parts of ox blood, separated in the slaughter-house from the fibrous part. This preparation is exceedingly strong. If a single stratum of red bole, mixed up with drying linseed oil, be then applied, it may soon after be waxed and rubbed. This application is solid, and costs less than the former. I have seen, in a house inhabited for thirty years, the floor of a hall painted in this manner, where the colour still retained its lustre without being in the least diminished.

I have communicated a very beautiful red colour also with a bath of alumed madder. A pound of madder coarsely pulverized, four ounces of alum, and twelve pounds of water, are sufficient for this preparation. Two strata of it are applied to new tiles, after which it is waxed and rubbed.

This application produces a very fine effect; but it is not so durable as the preceding.

Example VI.

Distemper in Badigeon.

Badigeon is employed for giving an uniform tint to houses rendered brown by time, and to churches when it is required to render them brighter. Badigeon, in general, has a yellow tint. That which succeeds best is composed of the saw-dust or powder of the same kind of stone and slaked lime, mixed up in a bucket of water holding in solution a pound of the sulphate of alumine (alum). It is applied with a brush.

At Paris, in the neighbourhood of that city, and in other parts of France, where the large edifices are constructed of a soft kind of stone, which is yellow, and sometimes white, when it comes from the quarry, but which in time becomes brown, a little ochre de rue is substituted for the powder of the stone itself, and restores to the edifice its original tint. But, at Geneva and Lausanne, and in the neighbouring cities, where buildings are constructed of molasse, a kind of soft freestone, the tint given by ochre de rue would be different from that intended. We are indebted to one of my fellow-citizens, the late Lagrange, for a method, both simple and effectual, of giving to old edifices a new appearance, and of reviving their original tint: it is adapted to the nature of the stone. Nothing is necessary but to rub the surface of the edifice with pieces of the same molasse, taking care to select the hardest: by this process the stone will acquire its former colour. It was employed at the time of the reparation of the church of St. Peter, our cathedral, forty years ago; and the state of that edifice still attests that none better could have been used.

SECOND KIND OF DISTEMPER.

Example I.

Varnished distemper. Chipolin.

Painting in distemper covered with a varnish called chipolin* and royal white, which will furnish an example of the third kind of distemper, is the most elegant of this sort; but the preparation it requires renders it very expensive. It is to chipolin that we

* The origin of the word *chipolin* is very uncertain. On this subject there are two opinions, which seem to have the same degree of probability. Some think it is derived from the resemblance observed between this kind of painting, when well executed, and cipolin or chipolin marble, in regard to the pearly or talc-like brilliancy which it acquires and retains when well polished. The first

are indebted for those brilliant decorations in varnish applied to candelabra with delicate sculpture, the argentine white of which, set off with pale gold, produces such beautiful effects by reflected light; but this truly noble kind of painting, in consequence of the great labour it requires, is reserved for valuable furniture, and for ornamenting apartments in palaces.

The eye dwells with pleasure on chipolin which has been executed with ingenuity and taste. The vanity of man ought to smile at the sight of those superb apartments where the splendour of the painting, heightened by the pale gold which combines so well in this species of it, attests at the same time the power of the owner and that of the arts, which subjects the sovereign himself to that tribute which they impose on taste and love of the beautiful.

Besides the splendour which this kind of painting acquires under the influence of the light, it possesses the property of keeping apartments cool. This effect, which would be produced by marble, must result also from chipolin. Being composed of very fine parts, which a state of solution brings into perfect contact, and whose adhesion is very much increased by the *gluten*, which gives them a very great consistence, its texture cannot be very much different from that of marble.

cipolin, perhaps, was only an imitation of this marble, and exhibited those greenish veins with which it is enriched and ornamented. Others suppose that this denomination originated from the use which the first painters in this branch made of the juice of onions, applied by way of preparation. Were I called upon to decide this question, I should declare in favour of the first opinion.

I have seen chipolin employed in the decoration of altars, which was harder than marble with crystallized grains. The latter is more susceptible of being scratched.

Though this kind of painting is not frequently employed, I think it necessary to give the reader a sufficient idea of it, by a short account of the process, as described by Watin in his *Parfait Vernisseur*; but I shall remove the veil of mystery which he throws over the composition of the varnish he would employ, were he to undertake chipolin. The following is the order adopted in the distribution of the labour for argentine white chipolin. In regard to further details, the reader must recur to the work above mentioned:

1st. Wash the wainscoting with a warm decoction of absynthium, to which a few heads of garlic are added. Mix this decoction with parchment glue, which when cold assumes the form of a jelly. This process opens the pores of the wood, and disposes it to afford the means of adhesion to the following strata.

2d. A stratum of warm glue with Bougival or Spanish white, which will give the work more solidity. White of Morat may be substituted for that of Spain.

3d. Eight or ten strata of the same white, well mixed and exceedingly fine; taking care to preserve the same degree of strength and the same thickness in each stratum. But care must be taken at the same time not to choke up the mouldings, and to apply the last stratum with glue somewhat thinner than that used in the preceding strata.

4th. Soften the surface with pumice stone, to which such a form has been given that it can be introduced into the small cavities of the mouldings and sculpture. Employ small sticks of different shapes to polish the mouldings and the plain surfaces. The process of polishing may be shortened by drawing immediately over the work a soft brush dipped in water.

5th. Clean the cavities of the mouldings and sculpture with small iron instruments prepared for that purpose.

6th. After these preparations apply two strata of colour made of white oxide of lead, to which a particle of prussiate of iron and black has been added, and mixed up with parchment size, strained through a sieve to separate the portions of size still granulated: these two strata must be softened with the brush.

7th. Apply two other strata of thin glue, beaten up cold, and strained through a sieve, to separate the portions of jelly not diluted. They are applied cold, carefully softening the work, that there may be no need of passing several times over the same place.

8th. Apply, with the same precautions, two or three strata of the varnish No. 2. of the first genus, or of No. 14. of the third; and keep the place warm, to facilitate evaporation and desiccation before the dust can adhere to it: the work will then be completed. Such is the process for this preparation, which requires eighteen or nineteen strata, and a great deal of care in the execution. It is needless to remind artists of the principle already laid down, *that a new stratum must not be applied till the preceding be dry*. When the chipolin is destined for pieces of sculpture, it is customary to heighten its splendour by that of gold, which is applied and left unburnished on all the salient parts of the work. This addition increases in a singular manner the richness and magnificence of this kind of decoration.

The author, who gives a more circumstantial detail of this labour, points out a method which was known to painters before the publication of his work, and which they employed with modifications, according to local circumstances, and to the time and expense which they were willing to sacrifice. This method is much shorter than the former, since it enables artists to imitate chipolin by an operation which requires only twenty-four hours: it will form the subject of the second example.

Example II.

Imitation of chipolin.

Watin prescribes two strata of size made of Spanish white, mixed up with strong parchment glue, hot, and even in a state of ebullition*.

* The application of size so hot swells the wood and retards the desiccation. The wainscoting, indeed, at Paris, and in the neighbourhood, is of oak, and this wood is less liable to swell than our fir at Geneva. I should apply the first two strata in this case with ceruse of the first quality: the tint is solid, and calls forth the coloured strata equally well. They ought to be applied with essence. Over these two strata I would apply two others of colour mixed up with pretty strong glue, kept liquid, and would polish after the first coloured stratum. These ought to be covered with two strata of varnish of the first class, or the varnish No. 14. of the third, or the colour should be mixed up with the varnish.

The desiccation is accelerated by maintaining a fire in the apartment which has been varnished, if the season be unfavourable.

When the second stratum is dry, rub it with pumice stone to equalize and smooth the surface, and apply three strata of colour. If an azurey gray white be required, mix with great care on a porphyry slab one ounce of ceruse, one gros of charcoal black, and as much prussiate of iron (Prussian blue). Take a portion of this mixture, and grind it slightly on the porphyry stone with the ceruse which is to compose the colour, adding the latter in portions, that the ingredients may be better mixed. When this first division is effected, sift the whole through a silk sieve to complete the mixture.

Then add four ounces of this preparation to a pound of varnish, and mix them with a brush. The varnish proper for this purpose is No. 1. of the first genus. It will be proper not to mix up more matter at a time, because the varnish evaporates. Extend it in as uniform a manner as possible, and when the stratum is dry, rub it with a strong new piece of linen cloth to polish it. This friction, which at first requires considerable care, completes the desiccation of the varnish, and glazes it. For the second stratum take only one half of the powder, and mix it up in the same quantity of varnish as for the first; and for the third only half an ounce of powder. If you are desirous of giving lustre to the work you must add a fourth stratum, not more charged with colour than the third. Then rub the surface with a cloth, to give it that splendour which always results from a perfect uniformity in the extension of the varnish.

This is the method which I have always employed in painting in distemper, and I recommend it for colours of every kind applied to wainscoting of white wood, which is too much liable to swell under size of every kind, and which renders the first preparation scaly.

THIRD KIND OF DISTEMPER.

Blanc de roi. Royal white.

This kind of distemper takes its name from the use made of it in decorating the interior of palaces. Royal white is very much employed, and is easily executed, when not intended to be covered with varnish: when fresh it is exceedingly beautiful. It is attended with the fault of becoming soon spoiled in apartments constantly inhabited, and particularly in bed-rooms, because, not being defended by varnish, the exhalations and other vapours which emanate from living bodies react on the white oxide of lead, and make it first turn yellow and then black. It is employed chiefly for saloons, where the mouldings and carving have been ornamented* with gold, the paleness of which is richly set off by the splendour of the colour. It is not customary

* The author here makes use of the word *rechampir*, which, in a note, he says is a term of art that signifies to contrast one colour with another. He adds, that it must not be confounded with the term *rehausser d'or*, which expresses painting of a gold colour on canvas, either in oil or distemper, and which represents pieces of sculpture, bas reliefs, &c.

to varnish white grounds when accompanied with gilding and beautiful ornaments.

In painting royal white, it will be proper to form the ground with a stratum of Spanish white, or white of Morat, mixed up with strong parchment size, and applied in a state of ebullition; paying attention, however, to the nature of the wood, as already remarked. It requires the same operations as chipolin; but private individuals generally dispense with this nicety of execution, which would require long time, and occasion very great expense. On this account I shall refer to the processes already detailed, in regard to the execution of azurey grayish white chipolin, which furnished the second example of the second kind of distemper. (See p. 512).

To render it very beautiful, white oxide of lead ought to be preferred to ceruse; and the insipidity of the white should be heightened with a small quantity of prussiate of iron or of indigo, in the same doses nearly as for pearl gray chipolin. Polishing with a cloth produces a very good effect; but the beautiful reflection of the light depends as much on the manner in which the last strata are applied as on the polishing which completes the smoothing of the surface.

In our happy country (Swisserland), where the luxury of apartments is confined within certain bounds which individuals never pass, where the citizen consults neatness and cleanliness rather than pomp and splendour, people are contented with the simple composition of royal white, heightening its dullness with a little prussiate of iron and black. This kind of painting is reserved, in particular, for the upper apartments of country houses. Its solidity renders it superior to that with white of Troyes. But all white oxides of lead are attended with the inconvenience of experiencing very sensible alterations in their colour at the end of a certain number of years, which renders it necessary to repeat the application of white in bed-chambers, or to cover them with varnish. The splendour given by this addition, and the easy means it affords of guarding against the pernicious effects of dust, are real advantages which counterbalance the expense.

Besides, though this preparation seems attended with no insurmountable difficulty, even to the amateur, it requires in the artist who undertakes it good taste, care, and practice. Royal white, indeed, is not always prepared with that care and attention which render it valuable. A skilful eye is often shocked to see the outlines of well executed wainscoting disappear under the unequal and too thick daubing of the strata, in which white of Troyes even is often substituted for ceruse. As this deception is frequently practised, people ought to be on their guard against it. The employer, who has a double interest to defend, may put the honesty of the artist to the test by a very simple experiment. Place on charcoal a small quantity of the white matter which represents ceruse; if it be chalk, it will become brown when you blow the charcoal; but if it be ceruse, it becomes yellow, changes to a red colour, and is soon reduced to lead. This revivification of the lead is speedier when the fire is urged by a blow-pipe.

Such are the resources which society derives from the combination of colours and compositions, the variety of which produced by diversity of tastes develops under the hand of the artist very powerful means, which have the threefold advantage, of adding new branches to national industry, gratifying the wants of individuals, and multiplying, at their pleasure, the enjoyments of life.

CHAPTER VI.

Of the instruments necessary in the art of varnishing: observations on the use of some of them.

It is generally believed, and without much examination, that the art of the painter requires more practice or experience than funds. A palette destined for the distribution of the colours, an easel to maintain the pictures at different heights, a rod to support the hand which directs the pencil, a few casts to serve as a guide in the drapery and different attitudes, brushes, and a brush-holder, are, it is said, the whole apparatus of the painter.

A good education, an extensive acquaintance with antient and modern history, as well as mythology, great knowledge of the world, a certain ease of circumstances capable of maintaining independence during the long period of study, and of facilitating travel, that he may familiarize himself with the beautiful models of antiquity, to correct his taste, and to fix it on the true beautiful and sublime kind of composition, and to enable him to acquire correct ideas respecting every species of painting and in regard to human nature, and in particular genius, are the requisites necessary to constitute a great painter. Genius unites the great painter with the great poet, and conducts them to the same end by different routes. The one captivates our senses by warmth of colouring, judicious arrangement, and correctness of design; the other seizes on the mind, and conducts it by the magic, the delicacy and elevation of his thoughts, and by the harmony of his verses. Venus displays as many graces under the pencil of Apelles as under that of Homer.

The scarcity of great painters proves that great talents are necessary to arrive at celebrity; a point to which all artists of every kind ought to direct their aim.

The house-painter and varnisher participates with the former only in the term which serves to denote his profession. The functions of the latter are different. He pursues an occupation merely mechanical, which requires only a certain degree of dexterity, taste, and experience. The former composes a great deal and consumes very little; the latter consumes much and does not compose at all, unless he adds designing to his art, which consists merely in a simple application of colours.

In cities of a certain extent the painter and varnisher is a dealer as well as an artist. For the most part he is provided with varnishes and colours of different kinds, sufficient for all the undertakings that may be offered to him, and to satisfy the demands of amateurs. The state of the painter and varnisher, considered in this point of view, requires a certain stock which does not admit of his being confounded with those workmen who confine their talents to a mere application of colours, and who purchase them as they are used.

The painter who composes his own varnishes, who manufactures his own colours, and who applies them, requires for his business a situation in which two essential conditions, extent and dryness, must be united.

In consequence of the first condition, the premises must be accompanied with a court or yard for the composition of the varnishes, in order that he may be protected, as well as his neighbours, from the damage which may be occasioned by negligence or other causes. The second condition relates to the care necessary to be employed in preserving the colouring matters, which are easily altered by moisture.

Whatever may be the dryness of the matters at the time of their preparation, there are some, and particularly substances of an earthy nature, and metallic oxides, which imbibe the moisture of the air, and even with great avidity. This moisture is not hurtful to metallic colours, when destined for distemper; but when intended for painting in oil or in varnish, the case is different. It injures the splendour of the colour; and this effect is more sensible with varnish than with oil.

Moisture prevents perfect contact between the colouring part and the excipient. With the concurrence of the air disseminated among the moleculæ of the colouring part, it produces that immense quantity of air bubbles which covers the surface of a colour when mixed up with oil. If the colour is mixed with varnish, this humidity precipitates a part of the resin which is the basis of it: the colour then granulates, runs into globules under the pencil, and breaks the contact in such a manner that it becomes as it were mealy. It cuts or changes the reflections of the light, and seems to tarnish its splendour.

But, as it is not always possible to obtain a situation according to one's wishes, great care and attention must be employed to preserve these compositions from humidity. They must, therefore, be kept in boxes of hard wood, such as oak or walnut tree; for white wood is a real filter to moisture. The same end may be accomplished by shutting them up in glazed earthen vessels with a large aperture. These vessels may be easily shut by cork stoppers covered with parchment.

Liquid substances require to be kept in glass or stone ware. Varnishes are kept in large strong glass bottles with a wide mouth, for the convenience of taking them out; but as light has a powerful influence on these compositions, and renders them thick, I would recommend wrapping up the bottles in sheep's skin or moist parchment, folding it round the neck, and tying it with several turns of packthread. This addition is attended with the double advantage, of guarding against the influence of light, and of preventing those accidents which result from blows.

Drying oils are less delicate than varnishes made with alcohol or essence. They may be preserved exceedingly well in stone-ware jars, in large bottles, or in leaden vessels with a wide mouth. Leaden vessels are not liable to those accidents which are most to be apprehended; and if this advantage be not sufficient to make them be preferred, they possess another well known and consistent with theory, which is, that they add to the drying quality of the varnish.

A table, weights, and scales, and a few boards to form shelves, are all the utensils necessary for the workshop of a painter and varnisher.

Of the laboratory; and instruments necessary for the labour.

The expense of fitting up a laboratory to furnish articles for common consumption will be very small. However, if to the making of varnish the preparation of different coloured lakes be added, it will be somewhat greater. The instruments indispensably necessary are:

1st. An alembic, constructed according to the principles explained in the first part of this work, with a refrigerator and portable furnace.

2d. A few bottles for receivers, that is to say, of a pretty large capacity, with different funnels of glass and of tin plate.

3d. Two or three copper basons of different sizes, according to the extent given to the establishment.

4th. Vessels of earthen ware to receive the varnish, which is strained through a cloth, and to contain the first deposit.

5th. Pieces of board of the same diameter as the earthen vessels, to serve them as covers. They are more convenient, and not liable to be broken like the earthen-ware ones commonly employed.

6th. Large glass jars furnished with funnels, and the latter with covers, for filtering the varnishes of the first, second, and third genera. (See the figure Plate V.)

7th. A cast iron pot, polished in the inside and furnished with a cover, for making varnish of the fifth genus.

8th. Different spatulas of wood, rounded at the end.

9th. A shovel and a pair of tongs.

10th. Two or three furnaces, of different diameters, and in particular a small one with a sand bath.

11th. A small iron hooped tub with handles to contain charcoal.

12th. An iron capsule, or small vessel with a short handle to take out the charcoal.

13th. Some glass matrasses of different sizes, for the immediate preparation of alcoholic varnish; which is effected by immersing the matrass into a bason, the water of which is raised to different degrees of heat up to that of ebullition.

14th. A fixed table, some small tables, and a few boxes.

15th. A flask filled with spirit of wine to prevent the consequences of burns.

If alcohol be applied the moment the accident happens, it prevents the rising of blisters, which retard the cure. If the burn be considerable, the application of fresh oil of eggs, and that in particular of a beautiful yellow colour, is the best topic to allay the pain and to promote a cure. Simple cerat, composed of one part of yellow wax and two parts of good olive oil, or of three parts in winter, produces an effect which may be compared to that of oil of eggs, and is less expensive.

16th. An iron mortar of from twelve to fifteen inches in diameter, with an iron pestle. A slip of brass for taking the matters from the bottom of the mortar, and an iron spatula for detaching the matters which often adhere to it in consequence of the contusion.

17th. Two or three pestles of hard wood, with pretty large heads.

18th. Different sieves of hair and silk. The latter ought to be close.

19th. Some small iron bullets for the pulverization of bodies which are apt to form themselves into a paste. Certain substances, such as indigo and the argillaceous oxides of iron, are easily pulverized with bullets.

20th. Troughs of plaster for drying lakes.

21st. A frame two feet in length, and from eighteen to twenty inches in breadth, for receiving the filtering cloth, when you are desirous of separating the water from the composition of lakes. The cloth charged with the sediment is removed to the plaster dryers, or to new bricks, which absorb the greater part of the water contained in the sediment. After each operation the dryers or bricks must be exposed to the open air to dry them, and to render them proper for their first use.

22d. Wooden boxes, and a few tubs of different sizes, for washing and precipitation on a large scale.

23d. A porphyry slab, fixed on a table or stand, furnished with a drawer, containing mullers or grinding stones; spatulas of iron, horn, or steel.

The stones employed for the extreme division of the colours vary in their nature. Some employ the hardest marble; others breche rock, and, in short, the hardest that can be found. The Italians use porphyry, a very hard kind of stone, which was exceedingly common in the time of the Romans. Some beautiful pieces of it are still found, from two to four feet square; but when of this size they are very dear.

24th. One or more flexible knives, called palette knives; spatulas of ivory or bone, and some leaves of horn.

25th. Some vessels of tin plate, for containing the ground colours.

26th. Brushes and pencils of different kinds.

There are several kinds of brushes. Some are composed of badger's hair. They are sometimes made of a flat form, and are then called varnishing brushes. Others are made of goat's hair, or of the fine bristles of swine, or of the wild boar. They are affixed to sticks of greater or less length, according to the purpose for which they are intended. When these pencils are large they are called brushes, and are employed for the strong parts of the work. Pencils are made also of the hair of the martin, of the very pliable hair of children, and of swan's down. The last are fixed into the barrel of a quill, and are used for delicate kinds of painting.

The use of brushes or pencils is not limited to one kind of painting. In general, they are employed in different branches of it. Artists who have much employment assign a brush to each colour: they take care to wipe them when the work is done, and to preserve them by covering them with water. Amateurs are not under the same necessity of applying them to particular colours, or of preserving them in this manner. One brush often serves them for different colours, if they take care to wash out the first colour before the brush be dipped in another. This may be easily done, if each brush be washed in the liquor suited to that which has been applied in painting. Water easily separates every colour in distemper, and essence of turpentine all those which have been mixed up with essence and with oil. In the first case the pencil is wiped with a piece of linen cloth; in other cases a sponge will answer the purpose, if it be wrapped round the brush and pressed strongly with one hand while the brush is drawn through it with the other.

In regard to those destined for varnish, washing in alcohol will restore them to their former state, if the varnish has been made with alcohol. Besides, if the varnish has been suffered to dry between the hairs, a few strokes of a hammer or mallet will pulverize and separate the resin which unites them into a solid mass, and by these means will restore to them the necessary pliability.

27th. A vessel of tin plate with a flat bottom and wide mouth, divided into two parts by a partition. Oil or essence is put into one of the cavities: when you wish to clean your pencil dip it in the oil, and press it between your finger and the edge of the partition, in such a manner that the oil stained by the colour shall drop into the empty cavity. Painters, from a principle of cleanliness, employ a small stick, which in this operation answers the same purpose as the fingers.

28th. Two palettes, one of walnut or apple tree, which has been well rubbed over with drying oil before it is employed for holding the colours. The oil is rubbed in until it refuse to take up any more. This kind of palette serves also for varnishing, if the painter follow both the professions; another palette of tin plate reserved for painting in distemper, in order that it may be placed on the fire when the size becomes fixed.

Such is the furniture of the workshop of the painter and varnisher, who follows all the branches of his art. The extent which a man of industry never fails to give to his undertakings, when they are crowned with success, may contribute to vary the form and multiply the number of the instruments which are here considered as necessary. These circumstances will always depend on the occasion he may have to facilitate the execution of processes on a large scale; but the account here given of the nature and number of the utensils considered as necessary for a painter, can in no case be thought superfluous. Let a real artist be placed in a workshop thus furnished, and he will find himself at no loss in conducting his business.

REPORT

Made to the committee of chemistry of the society at Geneva, for the encouragement of the arts, on this new treatise on the art of preparing varnishes, and of composing the colours mixed up with them.

By M. Senebier.

The art of making and employing varnishes is of a very modern date in Europe. If we except China and Japan, where there is reason to believe that this art was practised in very early times, we are acquainted with no nation that used it; and if the antients had any idea of it, it must have been lost together with the works which might have revived it. The antient authors make no mention of it, nor have any images been borrowed from it by their poets.

We are ignorant of the etymology of the word *varnish*, which some derive from the Greek word *bernice*, supposed to signify amber, and others from *vernus ros*, the vernal dew, because it seems to give a shining appearance to the leaves.

The discovery of varnish might be carried back to the fourteenth century, which was the period of the discovery of painting in oil: but it has no resemblance to varnish; and if the Chinese and Japanese preceded us in this art, it was rather owing to their having the juice of the *varnish tree*, so well suited to this operation, than to any researches made on purpose.

The lustre of the Chinese and Japanese works attracted the attention of the Europeans, and the descriptions given of them by the Jesuit missionaries induced artists to make attempts to imitate them. The advantages which this art seemed to promise excited their ardour. A taste for neatness, the necessity of preserving from moisture various articles of value, the splendour, lightness, and low price of different kinds of toys, and the desire of having elegant apartments and carriages, contributed towards the advancement of the art of the varnisher. At length the celebrated Martin, about the middle of the last century, established the importance of varnish, by the perfection to which he brought it in consequence of his employing amber.

But as it was necessary that the improvement of chemistry should have an influence on the progress of the art of varnishing, it is founded on knowledge which that science furnishes; as the substances employed in varnishes have been better studied, they can be combined and applied with greater facility. C. Tingry, therefore, was sensible of the advantage to be obtained by subjecting the art of the varnisher to the test of experience; and the manuscript he has presented to you, and respecting which you have charged me to make a report, is the result of this labour.

This art, on the first view, might appear trivial; but it adds to our enjoyments, lessens the ravage occasioned by time in various objects of value, is interesting to our commerce and manufactures, and may suggest some theoretic ideas which will not be useless to science. In describing an art it is necessary that artists should be instructed in regard to every thing that belongs to it; and that they should be made acquainted with the matters they employ, the method of using them, the instruments which may assist them, the dangers to which they are exposed, the means of guarding against them, and the care they ought to take to preserve in a sound state the substances necessary for their operations. A series of processes minutely detailed might, no doubt, answer their purpose; but in this case the artist would be a mere automaton, exercising his art in the same manner as the bees make their combs. This would not be enough at the present period, when genius, instead of being satisfied with what it possesses, still aims at improvement. It was, therefore, necessary that the artist should learn to think; that he should find matter for reflection in a rational description of his art, and in an account of the relation which exists between the processes prescribed and the principles exhibited to him. Such are the views of C. Tingry in the present work, divided into two parts: the first of which treats on varnishes so called, and the second of the colours used for painting intended to be covered by these varnishes.

The preceding reflections are applicable in particular to this art, which abounds with pretended secrets adopted in workshops. These secrets, if good, retard the progress of the arts, by concealing the means of improving them; and, if bad, they injure the artists who employ them. I am almost inclined to wish that these secrets may be always concealed from the whole world.

This work first contains an useful account of fifty-seven solid and fluid substances which are generally employed in the composition of varnishes; and of sixty-nine colouring substances often used along with them. The artist will here find information respecting their origin, their properties, and their uses, as well as respecting the adulteration of them, and the means of detecting it. The author shows also the falsity of some prejudices adopted by artists; gives new processes for the rectification of some essential oils, and for freeing fat oils from their greasy principles. He traces out the different modifications effected in turpentine by various methods; and as the arts are more interesting according to their general utility, it is satisfactory to observe here the advantage which might be derived from the products of the last mentioned substance in regard to the service of the navy.

The solid matters employed in the composition of varnishes ought to be more or less transparent; as it is necessary that they should form a kind of glazing on the bodies which they cover. They are all found in the class of resinous and gummo-resinous bodies. The liquids, for the same reason, ought to be colourless, that they may not lessen the transparency of the bodies which they dissolve; they must be volatile, that they may evaporate almost entirely, and free from every thing that might attract the moisture of the air, in order that they may more easily preserve the bodies to which they are applied :—of this kind are alcohol, ethereous oils, and some fat oils, which have been rendered drying.

It results, then, from the qualities essential to the substances proper for making varnishes, that a varnish is a transparent, dry, brilliant, and permanent surface, deposited by the fluid in which the resinous substances have been dissolved on the bodies it is destined to cover, and which speedily evaporates. This definition may serve to distinguish real varnishes from those which water seems to form on the bodies on which it falls, because they disappear with it in the same manner as the varnishes composed of water charged with gum or gelatin, and because they have little brilliancy and attract moisture.

As the varnishes made with spirituous and oily fluids, however, have no resemblance, C. Tingry has formed them into different genera, and these genera indicate by their nature the use to which they ought to be applied. By means of this division he has reduced a mass of recipes and secrets to a small number of general cases, which simplifies the art, and enables the artist to reflect on his operations, and to accommmodate them to the object he has in view.

The first genus is formed by the alcoholic varnishes: these are the most drying, and constitute five species. These varnishes have more splendour than solidity: they are applied to pasteboard and to wood.

The second genus contains alcoholic varnishes less drying than the preceding. They are indebted for this property and greater solidity to the nature of the resins employed: they are, however, applied to the same purposes as the former. C. Tingry observes, in his remarks on these two genera, that spirit of wine never becomes charged with a greater quantity of resin than one-third of its weight. This observation is important; because all formulæ prescribe a much greater quantity, the overplus of which is mere loss.

The third genus comprehends those varnishes which change the colour of the bodies to which they are applied, and those also called *mordants*. They are more pliable, mellower, and more solid than the former, yet equally durable. In these varnishes essence is substituted for spirit of wine. They are employed for grinding colours and forming grounds. They are applied to wood and metals, to which they give great lustre. These varnishes are used for giving to buttons the most brilliant colours, for making gilt leather, and for colouring articles made of *papier maché*. The varnishes applied to fine paintings are also placed in this genus. Experience has proved, at Geneva, the excellence of that made by C. Tingry. When he speaks of it, he describes, with great minuteness, a method of reviving pictures, by cleaning them before they are varnished.

The fourth genus is composed of varnishes made with copal of an ambery colour, combined with ether or with essence of turpentine reduced to a certain state. This genus and the following are distinguished from all the rest by their solidity.

A very drying varnish, without colour, free from any bad smell, and which, when applied to metals, forms a glazing as hard and as transparent as enamel is the kind, no doubt, which best answers the intended purpose; and this C. Tingry has discovered, by uniting copal to ether of a certain degree of concentration. It has a great resemblance to that made with essence; but though the preparation of it is easy and sure, and though it supersedes the necessity of varnishes of this kind made with essence, the author shows how to make the latter with or without an intermediate substance. As the latter have furnished some curious observations, I think it my duty to say a few words respecting them.

C. Tingry, in the year 1788, presented to our Society observations on the solution of copal in essence of turpentine. He there explained the cause why every kind of essence is not proper for this operation: he also showed, that the more essence differs from the the state of ethereous oil the more energy it has to dissolve copal; that its dissolving property, in regard to copal, is in the ratio of its density; that essence of turpentine, newly distilled, exercises no action on copal, but that it assumes this property after it has been exposed some time to the light; and that essence of turpentine dissolves copal at a heat below that of boiling water. He observed that essence is not proper for this solution, when it deposits an acidulous water; and that it gives spontaneously a concrete volatile acid salt, nearly similar to that formed in certain essential oils which have been long kept, and which, in my opinion, approaches near to camphor.

C. Tingry, after long researches on copal, furnishes new resources to artists to enable them to make this varnish and that of amber in a more certain manner; to give them their full splendour, and to avoid certain processes by which they might be deceived.

This copal varnish, in consequence of its hardness, may be substituted for transparent enamel: it has withstood on a box, for a great number of years, the continual friction of the pocket, though the same friction has destroyed the metallic ring which surrounded it. The author, therefore, has opened a new branch of industry for the manufacturing of foil and of various kinds of toys much used, in which transparent enamels, far more expensive and more hazardous in the execution, are employed. In a word, this varnish will supply enamellers with the easy and sure means of repairing those accidents which happen not only to transparent, but also to opake, enamel, as experience has shown in our manufactories.

The last kind of varnish comprehends fat varnishes. They are exceedingly solid, and dry very slowly. They are made with essential oils, or some fat oils, or with both these kinds of oil united and combined with amber or copal. These varnishes are distinguished by their transparency, their lustre, and their solidity. They may be applied, with advantage, to carriages, and utensils exposed to daily friction, such as stools, waiters, &c.

In treating this subject, C. Tingry shows how to distinguish drying oils from others, and furnishes new means for obtaining them with facility, by pointing out a process for oxygenating them when necessary.

The varnishes made at present are much superior to those of China, which are confined to three colours, red, yellow, and black; which require long tedious processes, prejudicial to the health of artists, and which are never proper for delicate articles. This antient nation may boast of expert and patient hands; but the Europeans have been guided by genius.

C. Tingry gives general precepts for making varnishes on a large scale. He collects every thing that ought to be expected from a learned chemist and experienced artist: he details the most successful manipulations, describes the most convenient form of the vessels, and prescribes the most appropriate methods for the filtration and clarification of the liquors. He makes known also a new alembic, which has the double advantage of facilitating the mixture of the matters during the operation, and of preventing the dangers, so common and so alarming, which arise from the fire in processes of this kind.

The second part of this work treats on the application of colours. The same order is here followed as in the former; and a description is first given of the colouring matters employed in varnishes.

To proceed with certainty in the composition of colours, it was necessary to have some principle to serve as a guide, This principle the author found in the fundamental colours, which exhibit the different refringibility of the rays of light by the prism: and as each colouring substance does not always give individually the required colour or shade, he establishes this colour and shade according to the effects produced by a mixture of the different rays refracted.

The author then describes the common processes for the composition of colours, and fixes the cases in which they can and ought to be employed, by showing the method of combining them with varnish.

He here stops to consider the different kinds of lakes employed in painting; that is to say, the colouring feculæ combined with alumine or calcareous earth. These productions, in consequence of their importance, deserved great attention: but it was still necessary to find out some more certain means than any before employed of ascertaining the fixity of the colour of lakes; and these the author has here given.

But as a knowledge of the manipulations employed in the preparation of colours is not sufficient, the author describes also the workshop of the varnisher as well as his operations. He insists, in particular, on the extreme division of the colouring matters used for colouring varnishes, and determines the cases in which the different varnishes ought to be employed: he prefers the application of varnish charged with its colour to transparent varnish extended over a coloured ground; because on applying a colour in distemper to wood, it is injured by being moistened with the size, which forces the coloured coating to detach itself in scales; but he supposes that wood intended to be varnished is very dry. The author, however, does not confine himself to details of this kind: he shows in what manner the expense may be lessened, without hurting the beauty of the work; and thus renders equal service to the artist and to his employer.

The author gives also a description of painting in oil, which he treats with the same care; determining the cases in which it ought to be preferred, and pointing out, according to circumstances, the oils and colours that ought to be employed, with the method of preparing and applying them.

As waxed cloth and waxed silk are, strictly speaking, varnished cloth and varnished silk, since no wax is used in the preparation of them, the author makes them the object of his researches, and with the more reason as this part of the arts had been entirely neglected by men of science, though it may become a capital object of commerce. He describes the method of manufacturing these cloths, which vary according to the use for which they are destined. He next describes the method of making the celebrated English court plaster, which is applied to cuts, and of detecting the spurious kind.

This part is followed by numerous details in regard to painting in distemper. As it is founded on the preparation of glue or size, the author makes known the different kinds; establishes the cases in which this kind of painting may be employed, and describes the different grounds necessary to be made, according to the colours intended to be applied to them: he describes with minuteness the different processes for each method.

The work concludes with precepts to colourmen and artists in regard to the preservation of the substances employed in varnishes.

The author appears to me to have treated in this work the art of the varnisher and that of the house-painter, &c., in a useful and complete manner. I am therefore of opinion that it merits the approbation of the committee of chemistry. I even request that the committee will prevail on the Society for the encouragement of the arts and of commere to thank C. Tingry for the labour he has undertaken, and to beg that he will suffer the public to enjoy the fruit of his researches, as it must improve the practice of an art, one part of which is universally employed, while the rest may produce new branches of industry, or facilitate and render more productive those already known.

ENGLISH AND FRENCH WEIGHTS.

THE translator thinks it necessary to inform the reader, that the quantities of the ingredients in the different formulæ given in this work for the composition of varnishes, &c. are expressed according to the old French denominations. As they could not be converted into correspondent English denominations without fractional parts, which would have been still more troublesome, and might have occasioned mistakes, he thought it better to leave them in their original state, and to subjoin a table of the French pound, with rules for reducing the French to English troy weight; but if weights be made according to the old French standard this reduction will not be necessary. In many cases, also, where the ingredients consist of ounces, no difficulty will occur.

The reader, therefore, is requested to observe that the old Paris pound, *poid de marc*, of Charlemagne contains 9216 Paris grains, which are equal to 7561 English troy grains. It is divided as follows:

1 pound - - - -	16 ounces.
1 ounce - - - -	8 gros or drams.
1 gros - - - -	72 grains.

Sometimes the gros is divided into 3 deniers, and the denier into 24 grains.

The English troy pound, of 12 ounces, contains 5760 English troy grains, and is equal to 7021 Paris grains.

The English avoirdupois pound, of 16 ounces, contains 7000 English troy grains, and is equal to 8538 Paris grains.

To reduce Paris grains to English troy grains, divide by 1·2189.

To reduce Paris ounces to English troy, divide by 1·015734, or the conversion may be made by means of the following table:

The Paris pound	=	7561	English Troy grains.
The ounce	=	472·5625	
The gros	=	59·0703	
The grain	=	·8204	

If Paris pounds, therefore, are given to be reduced to English troy grains, multiply by 7561; if French ounces are given, multiply by 472·5625: the product will be English grains, and so of the other denominations.

ERRATA.

Page 88, line 14, for *baked oils* read *boiled oils*.
119, line 8 from the bottom, for *First species* read *Third species*.
156, line 13, for *or* read *on*.
207, line 8 from the bottom, for *Sixth species* read *Seventh species*.

THE END.

J. Taylor, Printer, Black-Horse-Court, Fleet-street.