

loam, underneath which is alluvial mud, plainly in communication with the water of the Bodensee; so that a yielding slush is formed, which was the occasion of the catastrophe. At first the tank settled equally, and maintained a fair level; but eventually it lunged over quite suddenly in the position shown.—*Jour. of Gas Lighting*.

NEW BREWING APPLIANCES.

THE new brewing appliances which we illustrate have been brought out by Llewellyns & James, of Bristol. The first of these is Birrell's antiseptic hot grist mashing apparatus, which is illustrated at Fig. 1. In this system the heat from anthracite coal is filtered and forced into the grist, thereby imparting to it certain antiseptic properties, which, it is said, never leave the resulting wort. It expels all moisture, increases the dextrine, and strengthens the albuminoids. All the air used is sterilized and freed from atmospheric germs, and it is reported to be a very valuable invention for restoring slack malt and imparting antiseptic properties to the grist.

Fig. 2 represents a vertical section and Fig. 3 a plan of Leaker & Reffell's cone furnace and setting for brewers' fire coppers. This invention is designed to concentrate the heat from the fire directly on to the center of the copper bottom by means of the fire brick

not be boiled and distilled without change, thus differing from really volatile liquids. They are *glycerides*—that is, compounds from which glycerin, on the one hand, and fatty acids, on the other, are obtainable. These glycerides are named after the fatty acids which they yield. Thus olein is the glyceride of oleic acid, linolein the glyceride of linoleic acid. In reality three kinds or varieties of glycerides of each fatty acid are possible, but the oils used by painters consist almost entirely of one of these kinds. The formation of one of these glycerides may be expressed in words thus: One molecule of glycerin, reacting with three molecules of a fatty acid, yields one molecule of glyceride in question and three molecules of water. Conversely, under other conditions, one molecule of a glyceride, reacting with three molecules of water, produces one molecule of glycerin and three molecules of fatty acid. If, in this last reaction, we substitute for the water three molecules of an alkali, such as potash, we obtain glycerin as before; but, in lieu of the free fatty acid, we find that an alkaline salt of the fatty acid has been formed—such salt is a soap. Alkaline soaps, namely, those of potash, soda, ammonia, are soluble in water, which fatty acids are not. There are, however, other soaps which are insoluble in water, namely, the lime, lead, copper, and many similar metallic salts of fatty acids.

Oils, though insoluble in water, are easily soluble in

(CS₂), a compound of carbon and sulphur, which may be prepared cheaply by passing the vapor of sulphur through red hot charcoal. Of the pressure process for obtaining fixed oils there are two modifications. In the more usually adopted of these, the oily seed or other material is first heated, and then pressed while still hot; in the other modification the pressure is applied to the cold seed, etc. Heat and pressure give a more abundant yield of oil, but the product is less pure and less well fitted for use in painting. The bulk of the oils of commerce are thus obtained. Cold pressed oils remain clear in cold weather, are more fluid than hot pressed oils, and contain a smaller proportion of solid fats and of free fatty acids.

The most important drying oils are those of linseed, poppy seed, and walnut kernels; others are obtained from niger seed, sunflower seed, and hemp seed. The first place is due to linseed oil.

Linseed oil is obtained from the seed of the common cultivated flax (*Linum usitatissimum*). Linseed varies in size and color. The usual colors are a purplish brown and a reddish brown, but there is a nearly white sort—a mere sport or variety—which may be said to be straw colored. It is grown along with the brown variety in some parts of the northwest provinces of India, particularly in Nagpur, but no pains are taken to keep the strain pure. Through the kind offices of the Director of the Royal Gardens, Kew, the government of India were good enough to obtain a specially pure sample of some hundredweights of white Nagpur linseed, and to place it at my disposal. Attempts to grow it for seed in this country and in Belgium failed, but a large quantity of oil was expressed for trial and analysis. Messrs. Bell & Co., of 25 Oxford Street, obtained several gallons of oil by cold pressure; many artists have expressed their approval of the product. One advantage of this white seed is the ease with which the purity of a sample may be recognized by the eye, any accompanying weed seeds differing widely in color from the white linseed. The skin of the seed is, moreover, thin, the old drawn oil is nearly colorless, and the seed is particularly rich in oil, containing no less than 46 per cent. of its weight, although, of course, much less than this proportion is obtainable by cold pressure. In a hand press about 25 per cent. was the average yield. Of the common or brown linseed, our chief supplies come from Russia and India. The Russian seed is generally finer than the East Indian; it is, moreover, imported in a less mixed and impure condition. By screening, the greater part of the impurities are or may be removed, but it is sold on a basis of 4 per cent. impurity. The impurities consist of dirt, other oil seeds, such as mustard, rape, and gold of pleasure, and non-oily weed seeds. The presence of the last named, though it reduces the yield, is not otherwise objectionable,* but the same remark does not apply to the foreign oil seeds. Most of these contain non-drying oils, which mingle with the linseed oil when the sample is pressed and deteriorate its quality.

The percentage of oil in linseed varies between 28 and 45; by cold pressure 20 per cent. is the average yield; by hot pressure, 27 per cent.; by extraction with carbon disulphide, 33 per cent. The linseed oil in common use by artists is hot pressed oil, and is very rarely, if ever, obtained from absolutely pure seed. The seed should be kept three months before it is pressed. The expressed oil should be exposed to light in covered glass vessels or tanks, and kept at a temperature of 80° or even 100° F. for some time. It thus loses color and becomes clear, a slimy deposit being formed. When thus bleached and clarified, the oil should be preserved in corked bottles filled quite full; the longer it is kept the better it becomes for painting, provided the access of air is prevented. The specific gravity of good linseed oil varies very little. At 60° F. (15.6° C.) it is 0.935; a bottle which will hold 1,000 grains of water at this temperature will therefore hold but 935 grains of linseed oil. It expands considerably with heat, its specific gravity at 50° C. being 0.913 only. One part of linseed oil requires 36 parts of cold absolute alcohol for solution, but only four parts of boiling alcohol. It may be purified by solution in boiling alcohol or in petroleum ether. Other methods of purification are generally employed. Among these may be named the following: Filtration through felt or carded cotton and charcoal, and then through pyrolusite; agitation with a solution of common salt, followed by washing with water, and drying by a heat of 220° F.; treatment with one four-hundredth part of oil of vitriol, addition of hot water, washing, and drying. Various other processes and reagents have been employed for purifying and bleaching linseed oil. Aqueous solutions of sulphurous acid, green vitriol, potassium permanganate, potassium bichromate, and peroxide of hydrogen may be included in this list. The addition of 1 per cent. of oil of turpentine to the oil, and then passing a mixture of air and steam through it, has also been tried. Whatever process be adopted, no acid, saline matter, or moisture must be left in the oil. The general and usual result of all the very different kinds of treatment to which linseed oil is subjected, in the above named and in many other processes, seems to be the more or less complete removal of impurities. The effect on the properties of the purified oil is chiefly seen in its greatly increased rate of absorbing oxygen and consequent hardening.

The chemical composition of linseed oil may now engage our attention. Its ultimate analysis shows it to vary according to the method of extraction adopted, cold pressed oil containing about 78 per cent. of carbon, 11 per cent. of hydrogen, and 11 per cent. of oxygen; while the hot pressed oil contains nearly 3 per cent. less carbon, and nearly 3 per cent. more oxygen; linseed oil extracted by carbon disulphide is still poorer in carbon, and richer in oxygen. Linseed oil consists chiefly of four glycerides, called, respectively, linolein, linolenin, isolinolenin, and olein. A small, but variable, amount of free fatty acids is also present. The empirical formulæ of the four fatty acids of the above named glycerides are, respectively:

Linolenic acid	}	C ₁₈ H ₃₀ O ₂
Isolinolenic			
Linoleic	}	C ₁₈ H ₃₂ O ₂
Olein			

Linolein, which is present in linseed oil to the extent

* Occasionally these weed seeds give up, under pressure, certain matters which deepen the color of the expressed oil somewhat.

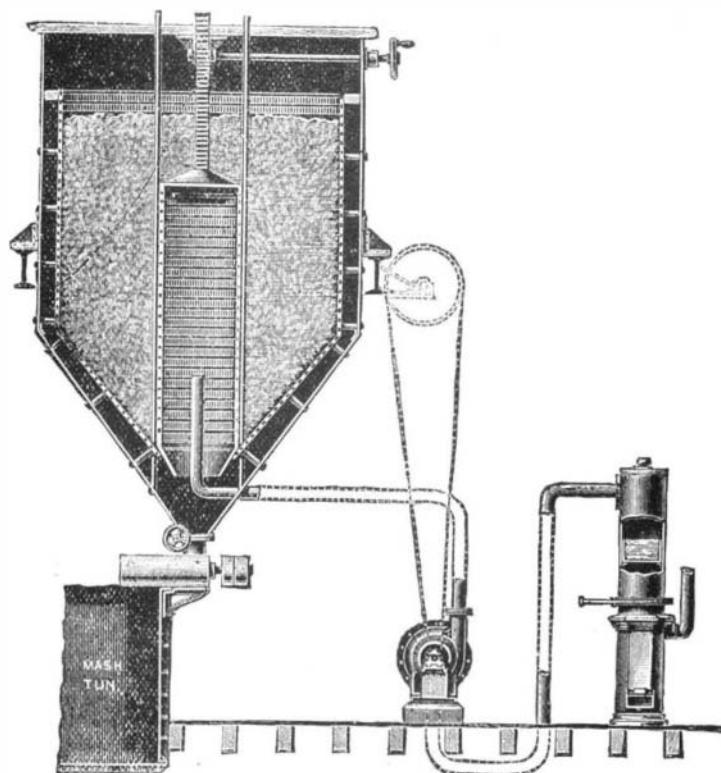


FIG. 1.

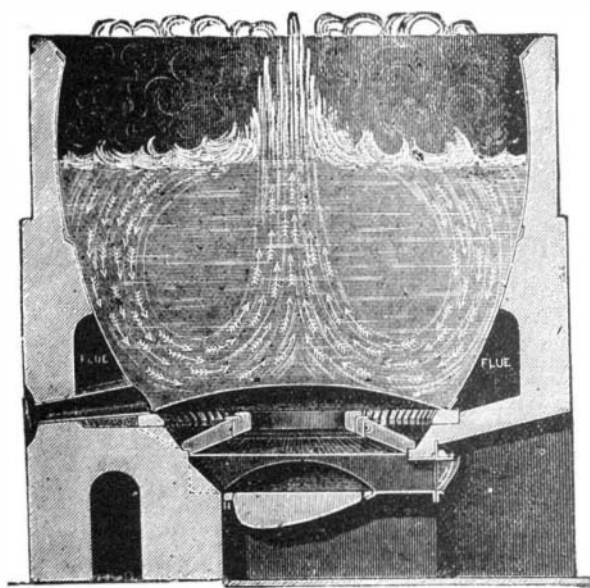


FIG. 2.

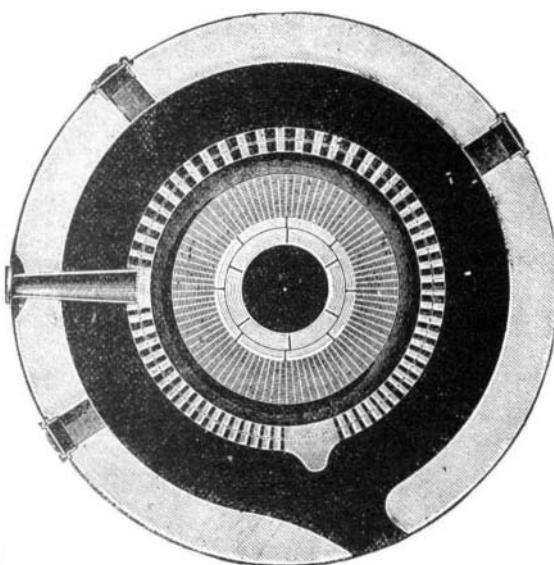


FIG. 3.

NEW BREWING APPLIANCES.

cone. It is found to give a thorough circulation of the wort, and a heavy central boil, thereby insuring proper aeration and effecting a saving in fuel. By reason of the circulating action of the wort, as shown in our engraving, it is prevented from boiling over, and when in work it is found that the wort is quiet around the sides of the copper under a most vigorous boil. There is no fear whatever of the copper being burnt, by reason of the effective circulation set up by the impact of the fire through the cone.—*Iron*.

LINSEED OIL AND OTHER OILS USED IN ART PAINTING.*

By Prof. A. H. CHURCH, M.A., F.R.S.

THE common usage of the term "oil" is wider and less definite than that sanctioned by chemists. We must exclude from the category of true oils petroleum and the liquid paraffins, spirits of turpentine, and the volatile essences of plants, the hydrocarbons of coal naphtha, as well as a number of other liquids which present certain superficial resemblances to the oils proper. Fats, however, belong to the same group, their solidity at ordinary temperatures being, so to speak, an accidental rather than an essential difference. The true oils are often called fixed oils, for they can-

spirit of turpentine, benzine, chloroform, liquid paraffins, and volatile plant essences; they are, in fact, miscible in all proportions with these liquids. There are other liquids in which the oils are less soluble, such as alcohol, ether, and glacial acetic acid.

Oils are divisible into two classes, one of which includes those which dry up and harden, forming a kind of elastic varnish, by exposure to the air. The oils of the other class do not harden, but become sticky and rancid in smell; these oils, however, if submitted to the temperature of boiling water for some time, in some instances become dry and hard, but the varnish they yield under these circumstances is dark in color and brittle. The painter's concern is almost exclusively confined to the oils of the first group, generally known as *drying* oils. To the most important of these attention will be directed presently, but the general methods of extracting them first demand a few words of explanation. There are two different processes in use. In one of these, which has been practiced widely from very early times, the oil is obtained by pressure; in the other process, invented some fifty years since, the oil is extracted by means of an appropriate solvent. We may dismiss this latter process almost summarily, for the product which it yields, though much greater in quantity, is decidedly inferior to that obtained by pressure. It is less fluid, and contains a larger proportion of solid fats. The solvent commonly employed to dissolve out the oil from oil-yielding materials is carbon bi sulphide

* Abstract from the "Chemistry of Paints and Painting," By A. H. Church.

of about 20 per cent., is the glyceride of linoleic acid, and has the formula $(C_{18}H_{32}O_2)_3$, $C_{54}H_{96}O_6$; or, as it may be written, $C_{54}H_{96}O_6$. The relation of this glyceride to glycerin may be seen when the latter body is expressed by the formula $C_3H_5(OH)_3$. It is probable that the two other main constituents of the oil—linolenin and isolinolenin—are similarly constituted glycerides, and that they closely resemble linolein in physical and chemical properties. When 100 parts of linseed oil are saponified by an alkali, they yield from 9.4 to 10 parts of glycerin.

The most important chemical property of linseed oil, from a painter's standpoint, is its behavior with oxygen. Under certain circumstances it absorbs oxygen to the extent of 12 or 13 per cent. of its weight, becoming converted into a mixture of substances for which it is convenient to retain the old name *linoxine*. Linoxine is solid, and not liquid; it is far less soluble than linseed oil in any solvent, and in many liquids it is insoluble. Linoxine is, moreover, denser than the original oil, and is also more bulky; 100 grains of linseed oil produce about 138 or 109 grains of linoxine. During the oxidation of linseed oil, the small quantity of olein it contains remains unoxidized, and its presence confers elasticity upon the product. The changes which occur during this oxidation are complex and ill understood; but there is some formic acid formed, so that the product is sour; carbonic acid gas and water are also produced. There are many ways of bringing about this oxidation. A very common one is to heat the oil to a temperature of at least 100° C., and to blow air through it, or air containing ozone. Many substances favor the absorption of oxygen by linseed oil under the above conditions. Among these may be named manganese dioxide, borate, oxalate, or linoleate; red lead, litharge, or lead acetate; green vitriol or white vitriol, etc. It is better to use one of the manganese compounds, and an excellent result is obtained with the borate of this metal. On the small scale the operation may be thus carried out: Tie up in a small piece of muslin 20 grains of dry and powdered manganese borate. Suspend the bag in a glass quart flask, into which a pint of linseed oil has been placed, so that the bag is just covered by the oil; lightly plug the mouth of the flask with some carded cotton. Stand the flask in a warm place, where the temperature does not fall below 40° C. nor rise above 100° C. In a fortnight's time the oil will have become strongly siccative, so that when it is spread in a thin layer on glass or paper, it will dry up to a tough varnish within twenty-four hours. If the oil and manganese borate be maintained by means of a water bath at a temperature of 100° C., the change will occupy less time, and the product will be just as good; but it is not advisable to *boil* the oil with the borate, although the change may be thus effected in less than an hour. The oxidation may be further hastened by occasionally blowing a little air into the oil through a glass tube kept permanently in the flask. When the rapid drying quality of the oil has been proved, by experiments made with a drop or two withdrawn for that purpose, the flask is allowed to get cold and the oil poured into a corked glass bottle so as to fill it. In the course of the next few weeks a slight deposit will be formed in the bottle; when this has occurred, the clear oil should be poured off into other bottles, and preserved for use. According to the purpose for which the prepared oil is to be afterward used, the treatment with the borate is to be more or less prolonged; but care should be taken not to carry it so far that the oil becomes rosy or viscous, unless it is intended to make linseed oil varnish. We shall often refer to this siccative linseed oil as "manganese oil." To the above directions for preparing this oil may be added the remark that if the operations be conducted in strong light, the oil will be bleached as well as rendered highly siccative. No satisfactory explanation of the action of the manganese borate (and of many other substances used for the same purpose) has been offered. But it seems probable that the absorption of oxygen by the oil is favored by the removal of certain impurities, and this the borate of manganese may effect.

The increasing specific gravity of the "manganese oil" as the process is prolonged may be used as an indication of the point at which the heating may be discontinued. When the oil has acquired a specific gravity of 0.945, it is generally sufficiently siccative for grinding with non-drying pigments, and as an addition to certain varnishes. For these purposes it may even attain a specific gravity of 0.96; but when it shows 0.99, or 0.995, it constitutes a thick varnish, which needs dilution with a suitable solvent. It may be well to remark here that the various processes for rendering linseed oil more rapidly drying may be regarded as resulting in two actions, partly consecutive, partly simultaneous. The first action, if it could, or did, occur alone, would yield a purified oil *apt* to dry quickly, but very slightly altered in composition; the second action is more profound, and gives rise to a thickened, denser product, in which the drying process has already commenced. In practice, the first action occurs almost, but not quite, uncomplicated with the second, when linseed oil is warmed with borate of manganese in a vessel to which atmospheric air has very limited access; the second action, which is of necessity associated with the first, takes place when a stream of air is blown through warm linseed oil, even in the absence of manganese borate, but far more quickly in its presence.

The superiority of the highly siccative oils prepared with borate of manganese (or the oxalate) over those in the manufacture of which lead compounds or white vitriol are used, is so decided that all description of the older and less satisfactory methods will be omitted. But there are two other ways of rendering linseed oil more siccative, which deserve a passing notice. Into a clear glass quart bottle an ounce of distilled water and an ounce of clean iron brads are first placed, and then one pint of raw linseed oil, agitation being avoided. The next day the bottle, placed in as strong a light as possible, is to be shaken frequently, the shaking being repeated every day, until a drop of the oil, when tested, shows a sufficient degree of drying character. Finally, the liquid part of the mixture in the bottle is poured into a separating funnel, and the aqueous part allowed to run away. The oil may require drying and filtration. In another similar process green vitriol is substituted for the metallic iron, the other directions being identical.

The most important property of linseed oil and

some methods for the further development of this property having been discussed, we may now describe the remaining characters of this oil. The cold pressed oil is very pale straw colored, or pale yellow, with occasionally a faint greenish hue; the hot pressed oil is a darker yellow or brown. The cold pressed oil, when considerably cooled, remains clear long after the hot pressed oil has become turbid. The fluidity of the oil is less than that of water in the ratio of 1:10. The hot pressed oil has a much stronger taste and odor than the cold pressed oil.

The adulteration of linseed oil with other oils may be recognized with more or less precision by means of several different tests. Most of these tests (oil of vitriol test, nitric acid test, etc.) produce reactions in which the oil and the acid acquire varied colors characteristic of different oils. The tests must be applied under exactly similar conditions of temperature, agitation, lapse of time, strength of acid, etc.; and even then, unless the experimenter is well versed in the work, the indications obtained are sometimes perplexing and difficult to interpret. The amount of bromine absorbed by a given weight of linseed oil, or better of the fatty acids obtained from it, affords a valuable test of purity. This amount of bromine is unusually high, much higher than that absorbed in the case of the oils likely to be used as adulterants. But such quantitative determinations can be properly performed only by the skilled chemist. Valenta's acetic acid test is, however, more easily managed. To apply this, take equal volumes, three cubic centimeters of each, of the oil and of glacial acetic acid (specific gravity, 1.0562); mix thoroughly and gradually, heat the mixture until the oil has completely dissolved, or the boiling point is reached. Immerse a thermometer in the liquid, allow it to cool slowly, and note the temperature at which cloudiness appears. The following temperatures are those at which this turbidity is produced in the case of several different oils:

Name of Oil.	Temperature of Turbidity.
Niger seed.....	49° C.
Linseed.....	57°
Sesame seed.....	87°
Almond.....	110°
Ground nut.....	112°
Rape seed, mustard seed, etc....	Not dissolved.

It will be seen from these figures that of these six oils that of linseed is, with one exception, the most soluble, and that the presence of such usual impurities as the oils of sesame, rape, and mustard tends to reduce the solubility, and hence to develop turbidity in the acetic acid sooner—that is, at a higher temperature.

The specific gravity of linseed oil also affords a valuable means of testing its purity. At 15° C. (60° F.) it is denser than most other vegetable oils.

Name of Oil.	Spe. Grav.	Name of Oil.	Spec. Grav.
Linseed.....	0.935	Poppy seed.....	0.926
Gold of pleasure.....	0.931	Sunflower seed.....	0.925
Hemp seed.....	0.930	*Black mustard seed.....	0.921
*Cotton seed.....	0.930	*Ground nut.....	0.918
Walnut.....	0.929	*Colza seed.....	0.914

* The four oils marked with an asterisk are non-drying.

Poppy Oil.—This oil is obtained from the seed of the opium poppy, *Papaver somniferum*. It is of a very pale straw color, often almost colorless, and is nearly free from taste and smell. By filtration through hot animal charcoal it may be completely decolorized. If the fluidity of water be represented by 1,000, that of poppy oil at 15° C. is 74. Its specific gravity at the same temperature is 0.926. Its chemical composition is near that of linseed oil; it contains the same four glycerides, but in different proportions, for it is mainly made up of linolein and olein. The large quantity present of olein causes poppy oil to be a less rapidly drying oil than linseed. Wolfen, in 1640, stated that poppy oil dries *throughout* in four or five days, while linseed oil forms a pellicle upon the surface. Joseph Petitot, writing from Geneva under date January 14, 1644, states that amber is a siccative for poppy oil. Poppy oil was introduced into painting in the beginning of the seventeenth century, after linseed and nut oil. Later on in the same century the Dutch painters acquired greater confidence in this more slowly drying oil, employing it not only in the painting process, but also for grinding their pigments, especially whites, blues, and pale tints.

Nut Oil.—This oil is obtained from the kernels of the common walnut, *Juglans regia*. Leonardo da Vinci directs it to be made from the peeled kernels in order to avoid the chance of darkening its color, and also causing the subsequent alteration of the tone of the pictures painted with it. The kernels were to be soaked in water first, before being peeled and pressed. The introduction of nut oil into painting followed that of linseed oil, and preceded that of poppy. Cold pressed nut oil is much paler in color, and has much less taste and smell than the hot pressed oil; it also differs in composition much in the same way that the cold pressed differs from hot pressed linseed oil. The constituent glycerides of the nut oil are the same in kind as those of linseed oil, but a larger proportion of linolein is present. Nut oil closely resembles linseed oil in its physical characters; its specific gravity, 0.929, is intermediate between that of linseed and poppy oil. Besides the three drying oils already described, we may name that expressed from niger seed, *Guizotia oleifera*. It is occasionally employed in grinding artists' colors as a substitute for linseed and poppy oil. Tea seed and camellia seed oils, and the oils extracted in Japan from the seeds of *Perilla ocymoides* and from the kernels of *Torreya nucifera*, are not of sufficient importance to demand description.

A few observations may now be offered as to (1) the action of certain pigments on oils; (2) the different amounts of oil needed for grinding with different pigments.

1. Action of Pigments on Oils.—The most common action is a physical one, in which the opacity of a pigment is gradually lessened in course of time by the more complete interpenetration of the oil between the particles. Thus yellow ochre and raw sienna, for example, darken in color because they become more translucent, just as a piece of oiled cream-laid paper is darker and yellower than the same paper when dry. The light which falls upon it plunges into it more deeply, and on reflection is more highly colored. In the case of such pigments as we have named, and several others, another cause is at work darkening and

modifying the color: this is the yellowing of the oil itself. And it is the pigments which require the largest proportion of oil for grinding which exhibit in a marked degree the phenomena in question.

A second action between a pigment and the oil with which it has been ground is the peculiar gelatinous or "livery" condition quickly assumed by some oil paints. This change is particularly noticeable with the cochineal and madder lakes. I have succeeded in obviating it by carefully drying the pigments at a temperature just under 100° C., before grinding them with oil, and by substituting for raw linseed oil a mixture of the "manganese oil," described in the present chapter, with some poppy oil. Those pigments which dry easily should be ground with more of the latter oil, those which dry with difficulty with more of the former. Sometimes pigments harden quickly in the tube itself; this change is due either to the siccative character of the pigments, or to the introduction of an actual "drier," or to the too copious use of a strongly siccative oil with those pigments which are naturally slow in drying.

The third action between a pigment and the oil with which it has been ground is of a distinctively chemical nature. The most striking example of it known occurs with flake white. The lead hydrate in normal lead white saponifies the oil, forming lead soaps with the fatty acid which it contains, and, at the same time, setting free a small quantity of glycerin.

2. The different amounts of oil required by different pigments may now be considered. As a rule, the densest or heaviest pigments require the least oil. A few pigments require an excess of oil in order to protect them from moisture or other injurious agents. Different authorities do not agree at all closely as to the amount of oil needed to make a workable oil paint from the same pigment. The following list gives the amount required by 100 parts in weight of 19 pigments:

Name of Pigment.	According to M. von Pettenkofer.	According to Winsor & Newton (1882).
White lead.....	12	15
Zinc white.....	14	15
Aureolin.....	19	200
Chrome yellow.....	75	32
Yellow ochre.....	240	75
Raw sienna.....	25	180
Vermilion.....	62	20
Madder lake.....	100	125
Terre verte.....	112	70
Viridian.....	112	75
Prussian blue.....	125	75
Cobalt blue.....	125	75
Ultramarine (artificial).....	..	37
Raw umber.....	..	100
Burnt umber.....	..	90
Bitumen.....	..	126
Brown madder.....	..	87
Burnt sienna.....	181	195
Bone black.....	112	110

The great differences in the above amounts of oil do not cause such serious results in the conduct of the process of oil painting as might have been expected at first, for they correspond in a measure to the relative bulks of the several pigments. We can use more copal or amber varnish to balance the excess of oil in some pigments, and so secure a uniformity of structure, texture, and rate of drying in the different parts of the work. It is, however, often convenient to remove some of the excess of oil from a pigment before using it, especially with the colors prepared by some makers.* This can be done by leaving the oil paint on a pad of blotting paper; but 3 in. cubes of plaster of Paris afford a far cleaner and surer method for the absorption of oil. It may be further remarked that the quantities of oil required by some of the pigments in the above table may be reduced by grinding them under greater pressure. Aureolin requires only 80 parts of "manganese oil" for each 100 of dry pigment, instead of 200 of linseed oil, and then yields a quick-drying and perfectly protected paint. Yellow ochre, raw sienna, and ivory black should be dried at 100° C. just before grinding, and then yield workable paints with less oil. The subsidence of vermilion from the oil in which it has been ground may be prevented by using "manganese oil" instead of raw linseed oil, and adding to it a small quantity of hard paraffin wax having a melting point not under 65° C.

SIZING OF PAPER BY MEANS OF ALBUMINATE OF AMMONIA.

ALBUMINATE of ammonia consists of substances that are found in milk and that are used for the same purposes as the gelatine of bones, leather, etc. It possesses the property of dissolving in water without leaving any residuum, and giving a milky liquid. In order to dissolve it, water at 15° C. in sufficient quantity to cover the whole is used. It is allowed to rest for the night. There thus forms a gelatinous mass in which the lumps are easily crushed. The quantity of water necessary to produce a milky liquid, no longer containing lumps and insoluble bodies, is then added. This method of dissolving the albuminate is excellent, and is more advantageous than the one that consists simply in agitating with hot water. Should it happen that, through a prolonged repose, the crust became too hard, a certain quantity of resinous size would be poured upon the latter, and the operation would be continued as above.

The liquor thus obtained is not changed by the addition of resinous size, and starch and the coloring substances employed have no action upon it. The albuminate of ammonia has the greatest resemblance to resinous size. Both are precipitated by the same quantity of sulphate of alumina, and this distinguishes

* Dr. H. Stockmaier, of Nurnberg, has found the following percentages of oil in certain oil paints from different sources which he has analyzed:
Flake white (Roberson & Co.)..... 16.2
Light red (Winsor & Newton)..... 41.0
Burnt sienna (Dr. Schoenfeld)..... 59.2
Chinese ochre (G. B. Moeves)..... 45.0