The essential points in the construction of a good ophthalmoscope are few and simple. The best material for the concave mirror is silvered glass, which should be very thin, in order that the margin of the central perforation may encroach as little as possible upon the effective area of the opening when the mirror is turned obliquely to the line of sight; any excess of thickness above 0.3 mm. is both unnecessary and injurious. The central hole should be about 3.5 mm. in diameter,* and its unpolished margin should be coated with a dull black pigment; the alternative expedient of removing the silvering from a small central area of the mirror is not to be commended. A mirror made of polished metal is more difficult to keep in order, and, unless in very perfect condition, reflects much less light than a mirror of silvered glass. The focal length of the mirror should be about 23 cm.; this is a convenient focal length for examinations by the indirect method, and in the direct method the effect is not very different from that of a plane mirror (*cf.* Figs. 3652 and 3654). The mirror should be so mounted as to admit of its being inclined about 25°, to the plane of the correcting glass, and it is very desirable that it be so arranged that it can be turned in its cell. For the latter reason, and also because the mirror, when lying flat in its cell, is in closer proximity to the correcting glass, the writer prefers the hinged mirror of Loring (Fig. 3683) to his tilting mirror (Fig. 3687).

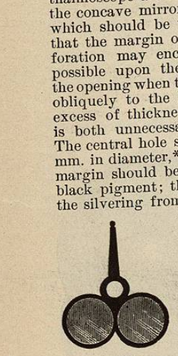


FIG. 3685.

FIG. 3686.

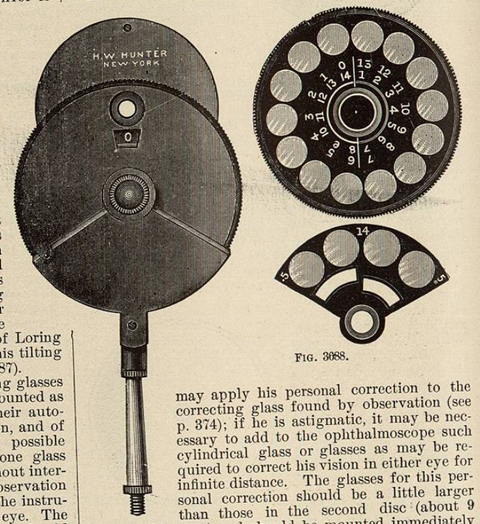


FIG. 3688.

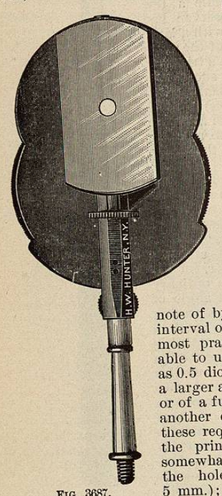


FIG. 3687.

The correcting glasses should be so mounted as to admit of their automatic centration, and of the easiest possible change from one glass to another without interrupting the observation by removing the instrument from the eye. The series of lenses should be sufficiently large to include the entire range of hypermetropia and of myopia, with intervals as small as can be taken note of by the observer; a common interval of 1 dioptrie will suffice for most practitioners, others may be able to utilize an interval as small as 0.5 dioptrie. A combination of a larger and a smaller Rekoss disc, or of a full disc with a quadrant of another disc, is sufficient to meet these requirements; the glasses in the principal disc should be of somewhat greater diameter than the hole in the mirror (about 5 mm.); those in the second disc or quadrant should be a little larger (about 7 mm. in diameter). The two discs should be as thin as the curvature of the glasses will permit, and they should be mounted in the closest possible proximity to each other and to the back of the mirror.

The handle of the ophthalmoscope should be not less than 14 or 15 cm. in length, measured from the centre of the mirror, and it should be large enough to admit of its being easily and firmly grasped by the hand. As, with this length of handle, it is somewhat difficult to reach the edge of the principal disc with the finger, a rack-and-pinion mechanism (Crétès), a cog-wheel (Loring), a train of cog-wheels (Noyes), or a cog and cam device (Meyrowitz), has been added; a very full series, of no less than seventy-four glasses, has been mounted, after the manner of an endless chain, in the place of the usual revolving disc (Couper);[12] a smaller series, similarly mounted, is used in the ophthalmoscope of Morton.

If the observer is simply hypermetropic or myopic, he may apply his personal correction to the correcting glass found by observation (see p. 374); if he is astigmatic, it may be necessary to add to the ophthalmoscope such cylindrical glass or glasses as may be required to correct his vision in either eye for infinite distance. The glasses for this personal correction should be a little larger than those in the second disc (about 9 mm. in diameter) and should be mounted immediately behind it; in astigmatism, of even as low a grade as 1 dioptrie, its correction adds appreciably both to the sharp definition of the picture and to the observer's quickness of perception.

Fig. 3684 shows the back of an ophthalmoscope made for the writer, in 1876, by Hunter.[13] It is, in fact, one of Loring's smaller ophthalmoscopes, with the addition of a second smaller disc—a construction adopted, a little later, by Badal, in France. Substituting $+13$ and -13 for $+14$ and -14, the order in which the glasses are brought into use becomes precisely the same as in the ophthalmoscope of Badal and in the later ophthalmoscopes of Loring; with $+0.5$ and -0.5 in the place of $+7$ and -7, as figured, an interpolation of 0.5 dioptrie may be made between the limits $+6.5$ and -6.5. A third disc, with two glasses, serving also as a cover to the smaller disc (Fig. 3685), or a setting of the form shown in Fig. 3686, affords the means of applying such correction as an astigmatic observer may find advantageous. The ophthalmoscope of Loring, with the tilting mirror, in the construction finally adopted by its author, is shown in Figs. 3687 and 3688.[14]

John Green.

* H. Knapp (Archives of Ophthalmology and Otology, iv., i., p. 41, 1874) made comparative trials of a number of mirrors with holes varying from 1 to 5 mm.; "the best illumination is obtained by an opening in the mirror of 3.5 or 3.75 mm. in diameter."

Plate XLVII., by Jaeger, shows the fundus of a normal eye as viewed by means of the ophthalmoscope.

[1] Couper: Report of the Fourth International Ophthalmological Congress, London, 1873.

[2] Helmholtz: Beschreibung eines Augenspiegels, Berlin, 1851.
[3] Th. Ruete: Der Augenspiegel und das Optometer, Göttingen, 1852.
[4] A. Coccius: Ueber die Anwendung des Augenspiegels nebst Angabe eines neuen Instrumentes, Leipzig, 1853.
[5] W. Zehender: Archiv für Ophthalmologie, I., i., 1854.
[6] F. C. Donders: On the Anomalies of Accommodation and Refraction of the Eye. The New Sydenham Society, p. 106, London, 1864.
[7] H. D. Noyes: Transactions of the American Ophthalmological Society, 1869.
[8] Ed. Jaeger: Oesterreichische Zeitschrift für practische Heilkunde, 7. März, 1856.
[9] E. G. Loring: Transactions of the American Ophthalmological Society, 1869.
[10] O. F. Wadsworth: Boston Medical and Surgical Journal, January 25th, 1877.
[11] E. G. Loring: Report of the Fifth International Ophthalmological Congress, New York, 1877.
[12] Couper: See description of Couper's new Ophthalmoscope, with illustration, in Juler's Handbook of Ophthalmic Science and Practice, London, 1884.
[13] J. Green: Transactions of the American Ophthalmological Society, 1878, p. 476.
[14] E. G. Loring: Transactions of the American Ophthalmological Society, 1878, p. 489.

OPIUM.—(U. S. P.; B. P.; P. G.) *Succus Thebaicus. Lachryma Papaveris, Extractum thebaicum, Meconium, Laudanum.*

DEFINITION.—Officially considered, under the authority of the United States Pharmacopœia, opium is "the concrete milky exudation obtained by incising the unripe capsules of *Papaver somniferum* L. (*P. officinale* Gmel.; *P. album* Mill., fam. *Papaveraceæ*), and yielding, in its normal moist condition, not less than nine per cent. of crystallized morphine" when assayed by the United States Pharmacopœia process. This definition is to be read in connection with the description given below, which more closely delimits the article. It is also to be considered in connection with the provisions for *Opii Pulvis* (see the section on Preparations), which has a different alkaloidal standard, and with those for the alkaloidal standardization of the preparations made from the latter.

FIG. 3689.—The Opium Poppy (var. nigrum). Plant much reduced. (Baillon.)

The definitions of other pharmacopœias differ considerably from that of ours. The German requires, as ours formerly did, that opium be produced in Asia Minor; also that it contain from ten to twelve per cent. of morphine and not more than eight per cent. of moisture. The British Pharmacopœia requires different amounts of morphine for the opiums used in the different preparations; not less than seven and a half per cent. for the tincture and extract, and between nine and a half and ten and a half per cent. for other uses. For diluting a higher with a lower grade, the United States Pharmacopœia requires that the morphine percentage of the latter be between seven and a half and ten per cent. In view of the standardization of the preparations, it would at first thought appear superfluous to impose rigid standards for the drug, but important commercial and tariff considerations are involved, aside from the fact that large downward variations in morphine percentages are liable to be accompanied by important upward variations in the percentage of other, perhaps undesirable, alkaloids.

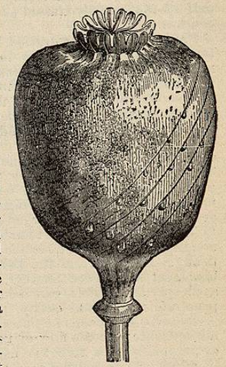


FIG. 3690.—White Poppy, showing the incisions made in the green capsule for the extraction of opium. (Baillon.)

Origin.—All opium is now regarded as the product of the one species named in our definition, though some botanists have been inclined to regard its varieties as distinct species. Although the plant grows abundantly in a wild state about the eastern Mediterranean, and in adjacent regions, opium is wholly the product of cultivated plants. Although the *var. glabrum*, having red flowers and usually dark seeds, is preferred and more largely grown in Turkey, and the *var. album*, with white flowers, is more commonly grown in Persia, such distinctions are not rigid, since flowers of all intermediate colors may usually be seen in a Turkish plantation. The opium plant here figured (Fig. 3689) is an annual herb, nearly a metre (a yard) high, somewhat branched above and bearing from five to twenty large flowers and capsules (see Fig. 3690). The latter is about as large as a small apple, and yields the opium by the process described below. (See section on Production.)

Almost every country possessing a suitable climate has yielded opium of fair to good quality, including Europe as far north as Sweden and North America as far north as New England, though most of these operations have been purely of an experimental character. Financial success in opium production requires a special combination of conditions affecting soil, climate, population, and cost of labor, and has been attained, to a noteworthy extent, only in Turkey, Persia, India, China, and Egypt. Of these products that only of Turkey answers perfectly to the official description, and it supplies practically the entire medical demand, except for purposes of morphine manufacture. For this, any product rich in morphine and easily worked is selected, the most of it, with the exception of Turkish opium, being Persian, so far as United States manufacturers are concerned. All other opium is consumed in the vicious practices of smoking and chewing. Of this, the Egyptian product is probably somewhat greater than the whole of the Turkish product, though smaller now than formerly. That of India is probably from ten to twenty times as great as that of Turkey, and that of China at least double that of the

rest of the world, including even the Indian. It will thus be seen that the vicious use of opium is about fifty times as great as its medicinal use, in connection with which it must be remembered that probably more than half of that usually classed as medicinal is in reality vicious.

Production and Preparation.—The best climatic conditions for poppy culture are those which prevail in the warmer wheat-growing sections—conditions under which it is practicable to sow in September, to trust to a covering of snow for the protection of the young plants through the winter, and to gather in the crop late in the following summer. More precarious, and generally less successful, is the production of a crop during the summer of the same year, the sowing being done in February or March. The capsules are ready for incision when just beginning to turn yellow, at which time the dense network of milk tubes ramifying through the entire thickness of the pericarp is charged with a thick milky juice. In Turkey the incisions are made in a somewhat obliquely or spirally transverse direction (Fig. 3690), in India vertically. In both cases the knife possesses two or three blades set near to one another, and the incision is made as deeply as possible, care being taken that it shall not penetrate the central cavity. This work is performed in the late afternoon, *i.e.*, at a time when the sun will not interfere with the flow of juice. In the morning, the exudation will be found to have thickened sufficiently to admit of its collection. It is considered that the quality of the Indian product is injuriously affected by the prevalence of very heavy dews. The opium is removed by a blunt scraping instrument, to which it is prevented from adhering in a troublesome degree by various devices; in Turkey, by the use of the saliva of the collector, in Persia by the application of a small quantity of oil. Owing to slight differences in the use of the scraper, portions of the epidermis of the capsule may or may not be removed with the opium. The collection of the Smyrna product naturally adds from five to eight per cent. to the weight of the opium from this source, and this amount is usually very largely added to. (See section on Adulteration.) As gathered, the opium is transferred to a poppy leaf held in the left hand, and the mass, when of convenient size, is laid away in the shade for a day's drying, which, if it has not advanced too far, will permit of the moulding of the product. When sufficiently dry it is enwrapped in the poppy leaf, and such masses may then, without further modification, be packed in Rumex capsules, to prevent their adhesion to one another, and marketed. They may, on the other hand, be subjected to very varied processes for various purposes. Considerable of the Persian opium is subjected to a long-continued kneading or beating process, with exposure to the atmosphere, so as to cause it to assume a resemblance in appearance to Constantinople opium. The latter variety is said to be similarly beaten up, so as to make it of a more homogeneous and finer structure. Much of the high-grade Turkish opium, and almost all of that of similar grade of other countries, is beaten up with that of lower percentage, to increase its bulk and weight. It is even said that some medicinal Turkish opium has thus mixed with it that of other countries. None of the operations above considered, though designed to reduce the morphine strength, can be regarded as acts of adulteration, so long as they do not result in reducing the morphine strength below official standards. Persian and Indian opium, instead of being wrapped in the poppy leaf, are usually wrapped in paper, and, since they are designed chiefly for exportation to China, they frequently bear inscriptions in Chinese characters. The masses are of varied forms, being in squares, cakes, cylindrical sticks, balls, or in masses similar to those of the Turkish article. Instead of being packed, like the Turkish, in Rumex capsules, they are usually packed in "poppy-trash," consisting of the chopped, dried capsules and other parts of the plants.

Adulteration.—The dilution of a high-grade, by the addition of a low-grade opium has been already considered. That by the addition of an excessive amount of the epidermis of the capsule or of the chopped capsules, or possibly of other parts of the plant similarly chopped, sometimes amounting to a third of the weight of the opium, or of an extract of the capsules, or of starchy substances, all of which are in themselves practically inert, may be considered, when they do not reduce the morphine strength below the official standard, as on the borderland between dilution and adulteration. The use of an extract made from the herbage of the plant is clearly adulteration, and is rather common, as is that of various gummy substances of an extraneous nature, and of earthy substances, some of them effervescing with acids. The use of such heavy bodies as stones, nails, and bullets, now less common than formerly, scarcely requires mention. The custom still prevails, to a greater or less extent, of diluting opium, after arrival in this country, so that it barely meets the official requirement, the product being known as *Pudding* or *Boston Opium*.

Description.—In irregularly globular, usually more or less flattened masses, weighing from 250 to 1,000 gm. (½ to 2 lbs.), the surface marked with the impression of a poppy-leaf used for wrapping, and frequently bearing fragments of this, with some rumex fruits; of a chestnut-brown or reddish-brown, changing to dark or blackish-brown with long keeping; plastic and rather soft, or gradually hardening from without inward, with age; fractured surface exhibiting more or less tissue fragments, together with small tear-shaped particles of opium and, under the microscope, some acicular crystals, especially visible after moistening with benzene; of a heavy narcotic odor and taste, the latter disagreeable and bitter.

The required morphine percentage has been stated under Definition. Although the official definition would permit the employment of the higher grades of opium from any country, it will be seen that the description, in view of what has been said concerning the different methods of wrapping and packing, would exclude all but the Turkish variety. Persian opium is light-colored and characterized externally and internally by an oily appearance. Egyptian opium is packed much like the Turkish, but is dark-colored and is almost if not quite invariably below the official standard in morphine yield. Indian opium is also dark-colored, usually possesses a peculiar odor, said to be due to fermentation during the long process of curing required by the peculiar conditions to which it is subject, and is commonly encased in coverings made by glueing together poppy leaves or petals by a substance made partly from a dark-colored exudation from the curing opium and partly from an extract of the plant. Very little of it is exported, except to China (*Provision Opium*), and this small quantity is restricted almost wholly to the Patna product. Chinese opium is mostly of very low grade, though of late some of much better quality has been produced. It is not of interest in materia medica.

Since it is required that the determination of the morphine percentage be accomplished by the official method, it is important that this process be here given:

Assay of Opium.

Opium, in any condition to be valued.. 10 gm.
Ammonia water .... 3.5 c.c.
Alcohol,
Ether,
Water..... of each a sufficient quantity.

Introduce the opium (which if fresh should be in very small pieces, and if dry, in very fine powder) into a bottle having a capacity of about 300 c.c., add 100 c.c. of water, cork it well, and agitate frequently during twelve hours. Then pour the whole as evenly as possible upon a wetted filter having a diameter of 12 cm., and, when the liquid has been drained off, wash the residue with water, carefully dropped upon the edges of the filter and the contents, until 150 c.c. of filtrate are obtained. Then

carefully transfer the moist opium back to the bottle by means of a spatula, add 50 c.c. of water, agitate thoroughly and repeatedly during fifteen minutes, and return the whole to the filter. When the liquid has drained off, wash the residue as before, until the second filtrate measures 150 c.c. and finally collect about 20 c.c. more of a third filtrate. The second filtrate, placed in a tared capsule, is first to be evaporated until it represents only a small volume; then to this is to be added the first filtrate; and, finally, after rinsing the vessel with the third filtrate, the evaporation is to be continued until the residue weighs 14 gm. Rotate the concentrated solution about in the capsule until the rings of extract are redissolved, pour the liquid into a tared Erlenmeyer flask having a capacity of about 100 c.c., and rinse the capsule with a few drops of water at a time, until the entire solution weighs 20 gm. Then add 10 gm. (or 12.2 c.c.) of alcohol, shake well, add 25 c.c. of ether, and shake again. Now add the ammonia water from a graduated pipette or burette, stopper the flask with a sound cork, shake it thoroughly during ten minutes, and then set it aside, in a moderately cool place, for at least six hours, or over night.

Remove the stopper carefully, and, should any crystals adhere to it, brush them into the flask. Place in a small funnel two rapidly acting filters, of a diameter of 7 cm., plainly folded, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter), wet them well with ether, and decant the ethereal solution as completely as possible upon the inner filter. Add 10 c.c. of ether to the contents of the flask, rotate it, and again decant the ethereal layer upon the inner filter. Repeat this operation with another portion of 10 c.c. of ether. Then pour into the filter the liquid in the flask, in portions, in such a way as to transfer the greater portion of the crystals to the filter, and, when this has passed through, transfer the remaining crystals to the filter by washing the flask with several portions of water, using not more than about 10 c.c. in all. Allow the double filter to drain, then apply water to the crystals, drop by drop, until they are practically free from mother-water, and afterward wash them, drop by drop, from a pipette, with alcohol previously saturated with powdered morphine. When this has passed through, displace the remaining alcohol by ether, using about 10 c.c., or more if necessary. Allow the filter to dry in a moderately warm place, at a temperature not exceeding 60° C. (140° F.), until its weight remains constant, then carefully transfer the crystals to a tared watch-glass and weigh them.

The weight found, multiplied by ten, represents the percentage of crystallized morphine obtained from the opium.

Constituents.—Not all of the alkaloids of opium here described occur in all the varieties of opium, the presence or amount of some of them depending upon varying conditions of production or preparation. Of the twenty naturally occurring alkaloids, the identity of which has been established, morphine and codeine, as well as their derivatives, apomorphine and apocodeine, and also narcotine, are considered under those titles. Although several of the others are somewhat used in medicine, they are not sufficiently employed to be entitled to separate consideration, and they are briefly discussed here and in the section on Properties and Uses. Besides these, quite a number of alkaloids have been obtained artificially by treatment of the others.

Morphine occurs in opium of different kinds and grades in amounts varying from a small fraction of one per cent. up to nearly twenty-five per cent. Its ordinary percentage varies from six or seven to twelve or fourteen per cent. In the medicinal Turkish opium, probably as the result of manipulation with that object in view, it occurs almost uniformly in from nine and a half to ten and a half per cent. It occurs in the drug as a compound with sulphuric acid or as one with meconic acid. *Codeine*, which exists similarly, rarely if ever reaches one per cent. in amount and sometimes does not exceed one-fifth of one per cent.

Narceine ($C_{23}H_{29}NO_9 + 2H_2O$) resembles narcotine in appearance, though the crystals are finer and more slender and are slightly bitter. It melts at 145.2° C. (291.6° F.), is insoluble in ether, but is somewhat soluble in water and in alcohol. Nitric acid colors it yellow, though the color is evanescent; iodine, in small amount, gives it a blue color; Erdmann's reagent produces a deep yellow tint, becoming brownish, then orange; finally, Frohde's reagent produces a brownish-green color which first turns yellow and then red. Like narcotine, narceine is but weakly basic. Its salts are crystallizable and are mostly incompatible with water, being precipitated or decomposed by it. Its hydrochloride is mostly employed and is strongly basic.

Thebaine ("paramorphine," $C_{19}H_{21}NO_3$) usually occurs in strongly lustrous scales, but sometimes in prismatic crystals. It is soluble in alcohol, benzene, and chloroform, and to a considerable extent in ether, and is insoluble in water. Its melting point is 193.4° C. Sulphuric acid colors it blood red, changing to yellow, nitric acid colors it red, Erdmann's reagent orange-red, Frohde's orange-yellow, slowly disappearing. It is decomposed quickly by diluted acids, with a production of the two isomeric uncrystallizable alkaloids *thebenine*, and *thebaicine*. It yields readily crystallizable salts.

Papaverine ($C_{20}H_{21}NO_4$) occurs in colorless acicular or prismatic crystals, soluble in hot alcohol, chloroform, and benzene, only slightly so in ether and cold alcohol, and insoluble in water. Its melting point is 147° C. (296.6° F.). It is colored purple or violet by warm sulphuric acid, violet-blue, becoming blue, yellowish, and colorless by Frohde's reagent. It yields salts readily and these are somewhat soluble in water.

The remaining alkaloids occur only in very minute amounts, and are merly objects of curiosity in materia medica. They are:

Codamine ($C_{20}H_{25}NO_4$), *Cryptopine* ($C_{21}H_{23}NO_5$), *Gnoscopine* ($C_{22}H_{23}NO_7$), *Hydrocotarnine* ($C_{12}H_{15}NO_3$), *Lanthropine* ($C_{23}H_{25}NO_4$), *Laudanine* ($C_{20}H_{25}NO_4$), *Laudanosine* ($C_{21}H_{27}NO_4$), *Meconodine* ($C_{21}H_{23}NO_4$,) *Oxynarcotine* ($C_{22}H_{23}NO_8$), *Protopine* ($C_{20}H_{19}NO_5$), *Pseudomorphine* ($C_{34}H_{36}N_2O_6$ "Phormine" or "Oxydimorphine"), *Rhoeadine* ($C_{21}H_{21}NO_6$), *Tritopine* ($C_{42}H_{54}N_2O_7$), and *Xanthaline* ($C_{37}H_{36}N_2O_9$).

Next to the alkaloids, the most important constituent of opium is about four per cent. of meconic acid ($C_7H_4O_7$), occurring free and in the alkaloidal salts. It can be extracted by the addition of lime, as calcium meconate. It occurs in colorless scales or prismatic crystals, soluble in alcohol and in hot water. It is colored deep red by ferric salts, the color not being destroyed by hydrochloric acid or by chloride of mercury or gold. It is tribasic and is decomposed, by boiling, into *comenic* and *pyrocomenic acids*.

A variable amount of lactic acid occurs in opium. *Meconin* and *Meconoisin* are neutral principles. The former ("opianyl") is in colorless, odorless, shining, bitter prismatic crystals, melting in the air at 110° C. (230° F.) and is soluble in alcohol and ether, slightly in water. It gives a green color when evaporated with sulphuric acid, with the addition of a little water. The latter has a somewhat higher melting point and yields a red, changing to a purple color, on similar treatment with sulphuric acid.

Among the less important constituents of opium neither starch nor tannin occurs. There is a varying amount of resin, a caoutchouc-like substance, gum, pectin, fixed oil, wax, glucose, coloring matter, and a volatile odorous principle.

Action and Uses.—A consideration of the actions of the more important constituents must precede those of opium. Those of morphine, codeine, and narcotine have already been considered under these titles. Of the minor constituents, the odorous principle of opium is often objectionable to the senses, and is removed in the *Opium Deodoratum* or *Deodorized Opium* (*Opium Denarcotisatum*, United States Pharmacopœia, 1880) by repeatedly washing with ether, and adding to the dried residue enough

sugar of milk to restore the product to its original weight. This treatment is supposed to remove also the narcotine, and probably most of the thebaine, the latter result greatly affecting its physiological action.

Thebaine.—This alkaloid is to be regarded as the principal constituent antagonistic to morphine, and hence to the general action of opium. It is a powerfully poisonous irritant of the spinal centres, producing convulsions. Therapeutical uses for it have not been developed.

Narceine acts very similarly to morphine, but is much weaker; its employment is vaguely stated to be free from the disagreeable after-effects of the latter drug, while others regard it as practically inert. Probably much of that used has been contaminated with morphine, yet the use of its numerous salts with organic and inorganic acids, has fully demonstrated that it does possess activity. Its dose is about the same as that of codeine 0.025–0.05 gm. (gr. $\frac{1}{2}$ to gr. $\frac{3}{4}$). None of the other alkaloids is known to be of importance in medicine.

Meconic Acid, though of no importance physiologically, has been considerably employed in compounding salts of alkaloids, under the impression that these, being the natural forms of occurrence in opium, were more diffusible and active than other salts. In this view, it was long official in the British Pharmacopœia, but the idea has now been abandoned and the substance is little used.

Opium.—From the foregoing it would appear that the action of opium should be that of morphine, except for the slight modification due to the presence of its thebaine. In the main, this is true, yet practice demonstrates differences which cannot thus, nor in any positive way, be accounted for. Doubtless the difference is partly due to the substitution of primary effects, when used in one form, for secondary effects when used in the other. In opium, as in most nervines, such primary and secondary effects are more or less antagonistic, as specially exemplified in its effects upon intestinal excretion, where a dose, relatively very small or very large, in consideration of the condition of the patient, is liable to increase peristalsis and discharge, while the characteristic effect of a moderate dose is to constipate. That opium should be less promptly hypnotic, producing more of a preliminary excitation of the spinal and lower cerebral centres, commonly with irritable pulse, can be readily charged to the action of its thebaine. It is difficult, however, thus to explain its greater intestinal astringency or constipating effect or its peculiar diaphoretic properties.

From a therapeutical standpoint opium can be used for all the purposes for which morphine is employed, though the dose should be relatively somewhat larger; that is, a dose of opium should contain more morphine than would be employed as a salt for the same purpose. Even with this proviso opium is not to be selected in preference to morphine for ordinary somnifacient purposes, since its action cannot be so accurately estimated, nor is it so prompt. On the other hand, there are cases in which it is to be preferred, even for such uses, since its after-effects are not so disagreeable or lasting as those of morphine. For checking intestinal discharges, opium is greatly to be preferred, though its continued use is not so constipating as that of morphine; often, in fact, it tends to looseness of the bowels. When it is necessary to maintain for some time an equable analgesic effect, as in relieving abdominal pain in peritonitis, for instance, opium is usually to be preferred, though it is sometimes desirable first to get the patient under its influence by the use of morphine. Subject to the above modifications, the specific actions and uses of opium should be sought under *Morphine*.

Special Uses and Doses of the Preparations.—(It is to be remembered that the doses of opium and its preparations are subject to the same enormous special variations as are those of morphine.) Of opium itself there is but one official preparation, namely, the *Opii Pulvis* or powdered opium, from which all the other preparations are made. This discrimination is of practical importance, since powdered opium must contain between thirteen and fifteen per cent. of morphine, about a half more than the lowest allowable (and usual) content in opium. It is specified that powdered opium of too high a percentage may be reduced to the proper strength by mixing in due proportion with that of a lower grade. Whenever the dose of opium is stated, it is powdered opium, which is to be understood. For ordinary purposes, this is 0.066 gm. (gr. i.). The substance is often given without change, much oftener in the form of the pills (*Pilulæ Opii*), each containing the above-mentioned amount, with a little soap, or in the deodorized form, mentioned at the beginning of our paragraph on Actions and Uses, its strength and dose being equal to those of powdered opium. Crude, undried opium is occasionally given in pill form when slow solution is desired, as in cases of relaxed intestine, diarrhœa of phthisis, and chronic dysentery. Old and hard pills are sometimes written for (and many apothecaries keep them on hand for the purpose), in the hope that they will pass the stomach undissolved and exert a local continuous influence upon the intestine. This result is, however, not exactly within control, and may be better attained by coating pills with keratin. More often still, when the effect of solid opium is desired, the extract (*Extractum Opii*) is given, its morphine strength being eighteen per cent., and the dose from half as large to as large as that of powdered opium. The above-named are favorite forms for the administration of opium when it is desired to produce a constipating effect, to restrain intestinal peristalsis and relieve the pain dependent thereon, to relieve irritation dependent upon extreme purgation and irritant poisoning, and to stay nearly all forms of abdominal inflammation. In these cases the grain of opium is often combined with three or four grains of lead acetate. In this connection, the external employment of the "lead and opium" wash must not be forgotten. Its effect in relieving pain and averting or reducing inflammation in and underneath the skin are sometimes magical. It is made by dissolving one hundred and twenty grains of lead acetate in about ten ounces of water, adding one-half a fluidounce of tincture of opium, and water enough to make sixteen fluidounces. It should be shaken well before using.

The simple liquid preparations are the tincture (*Tinctura Opii*), or laudanum, the deodorized tinture (*Tinctura Opii Deodorata*), the vinegar (*Acetum Opii*), and the wine (*Vinum Opii*), all containing ten per cent. of powdered opium and between 1.3 per cent. and 1.5 per cent. of morphine, and exhibiting no important difference in physiological action, the selection being based chiefly on the basis of odor and flavor, and the ordinary dose of each being ten minims. Laudanum contains its opium in a mixture of equal volumes of alcohol and water. The deodorized tincture bears the same relation to laudanum that deodorized opium does to powdered opium. It is made from powdered opium, the deodorizing process being part of its manufacture. The vinegar contains three per cent. of nutmeg and twenty per cent. of sugar in dilute acetic acid. The wine is made with a mixture of white wine and fifteen per cent. of alcohol, and contains one per cent. each of cloves and cassia cinnamon. The action and uses of laudanum may be taken as the type of those of this group. It is used in cases similar to those in which opium is itself employed, but where a more prompt effect is desired. It is a favorite preparation for relieving the convulsions of puerperal eclampsia, as much as a fluiddrachm being often given and repeated once or twice if necessary. In some forms of hemorrhage connected with pregnancy or delivery, large doses are also commonly employed. Laudanum constitutes a favorite addition to poultices, for relieving superficial pain, and it is frequently rubbed in with liniment or applied with lime liniment to relieve pain when not deeply seated. In spite of the fact that absorption of morphine by the skin is slight, such treatment is of undoubted value. Laudanum is very commonly applied on pledgets of cotton to aching teeth or ears, though the latter treatment is not always to be recommended.

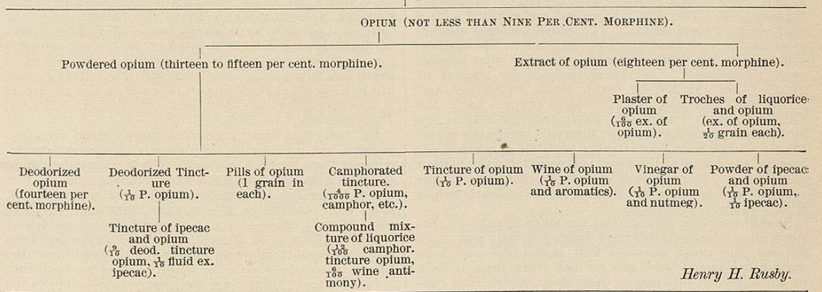
There are several mixed preparations of opium which

are of great importance, paregoric (*Tinctura Opii Camphorata*) being perhaps the most so. This preparation contains only 0.4 per cent. of opium, with the same amount each of benzoic acid, camphor, and oil of anise, together with four per cent. of glycerin in diluted alcohol. It has no alkaloidal standard. Paregoric constitutes a most excellent combination of a carminative with an analgesic, and is of the greatest value in relieving abdominal pains which present such indications. It is pre-eminently the form of opium for administration to children; but it is to be borne in mind that its continued administration, through the inattention rather than the direction of the physician, has frequently been the means of leading to the formation of an opium habit. The dose of paregoric is 4–15 c.c. (fl. ʒ i.–iv.).

The brown mixture or compound mixture of liquorice (*Mistura Glycerrhizæ Composita*) contains twelve per cent. of the camphorated tincture of opium with six per cent. of wine of antimony, three per cent. each of the extract of liquorice and the spirit of nitrous ether, five per cent. of syrup, and ten per cent. of mucilage of acacia. The dose is about 16 c.c. (fl. ʒ ss.). This preparation is in its nature somewhat similar to the Dover's powder, being a much used expectorant and diaphoretic, with distinct diuretic properties also.

Dover's powder (*Pulvis Ipecacuanhæ et Opii*) contains ten per cent. each of powdered ipecac and powdered opium in sugar of milk, the dose being 0.66 gm. (gr. x.), and the corresponding liquid, often spoken of as liquid Dover's powder (*Tinctura Ipecacuanhæ et Opii*), consists of ten parts of the fluid extract of ipecac in one hundred parts of the deodorized tincture of opium (corresponding to ten per cent. of opium), the whole reduced by evaporation to one hundred parts; the dose is ten minims. The last-mentioned two preparations constitute a remarkably useful combination of a diaphoretic with an analgesic and somnifacient action. In this diaphoresis both elements play their own peculiar part. An approaching "cold" can frequently be averted by a full dose of either, with a few hours' rest. An irritable cough, preventing rest, is relieved by the hypnotic effect, while the condition itself is benefited by the diaphoresis. The troches of liquorice and opium (Trochisci Glycyrrhizæ et Opii) each contain 0.15 gm. (about gr. ij.) of extract of liquorice, 0.005 gm. (gr. $\frac{1}{10\,0}$) of powdered opium, with sugar, acacia, and a little oil of anise to flavor. They are very useful in allaying throat irritation and mildly promote expectoration. By adding a little ipecac or tartar emetic the effect of Dover's powder may be simulated in mild degree.

The following table exhibits the preparations of our Pharmacopœia and the proportion of opium in each:



Henry H. Rusby.

OPIUM HABIT. See *Insanity: Drug Habituation and Intoxication.*

OPIUM, POISONING BY.—The poisonous nature of opium, and of the poppy, was known to the ancients as early as the time of Nicander (185–135 B.C.), who gives a clear description of the toxic effects of a "drink prepared from the tears which exude from poppy heads." Dioscorides, three centuries later, refers to the lethal effects of the poppy, and describes the method by which opium was then obtained, a method which does not sensibly differ from that which is practised at present. Pliny (A.D. 70) speaks of the toxic powers of opium, and cites the instance of Post. Licinius Cæcina, who, disgusted with life, terminated his existence with opium—an instance which was by no means singular, as the narrative concludes with "item plerosque alios."

In modern times (since 1600) we can find mention of but twelve cases of homicidal poisoning by opium or its preparations or derivatives, of which two were by laudanum and the remainder by morphin. Suicidal and accidental poisonings by the opiates are of very frequent occurrence. Probably thirty to forty per cent. of non-homicidal poisonings in the United States and in Great Britain are caused by these poisons. The widespread use of "soothing syrups" and other similar nostrums containing opium is unquestionably a factor in the high percentage of infant mortality.

Symptoms.—The symptoms produced by opium and its preparations, and by morphin—acute meconism—are practically the same, whatever preparation of opium or salt of morphin may have been used. Other things being equal, however, morphin and its salts are more rapid in their action than opium or the preparations made from the crude drug.

The *time* at which symptoms manifest themselves is usually from half an hour to one hour after the poison has been taken. Frequently this period is much shortened. In children who have received large doses the poison sometimes begins to produce its effects within a very few moments or almost immediately. When the poison has been introduced by hypodermic injection, it acts more rapidly than when taken by the stomach. Opium in solution acts more promptly than the same substance in the solid form, and the salts of morphin are more rapid in action than the alkaloid itself. Opiates administered by the rectum are more rapid in their action than when given by the stomach. The symptoms appear earlier when the poison is taken while fasting than when it is taken upon a full stomach. In exceptional cases the interval between the taking of the poison and the appearance of its effects is very much shortened even in adults. Thus, 45 c.c. of Liquor opii sedativus has caused total insensibility in fifteen minutes, and death in an hour and twenty minutes. Cases have also occurred in which the action of the poison has been much retarded, although taken in solution. Thus, instances are recorded in which no symptoms were produced in nine, twelve, fourteen, and eighteen hours by 45, 15, 60, and 45 c.c. of laudanum.

The clinical history of acute morphin or opium poisoning may be divided into three stages.

The first period, that of increased nervous excitability,