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January

1886

AN

EPHEMERIS

OF

MATERIA MEDICA, PHARMACY,

THERAPEUTICS

AND

COLLATERAL INFORMATION.

VOLUME II.—1884 and 1885.

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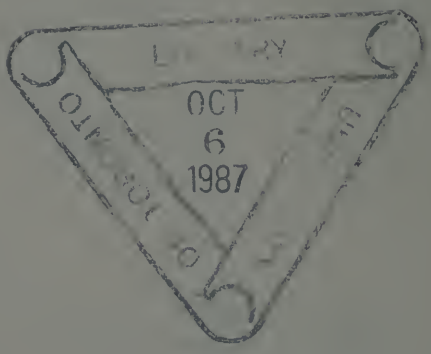
BROOKLYN, N. Y.
1885.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AN EPHEMERIS

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MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. JANUARY, 1884. No. 1.

THE DISCUSSION ON MEDICAL ETHICS.

The annual meeting of The N. Y. State Medical Society occurs at Albany this year on Tuesday, February 5th. At this meeting three distinct propositions in regard to the ethical question, laid over from the last meeting, will come up for action. The first of these in order is the no code proposition, or the declaration and resolution to abolish the present new code. The second in order is a proposition to repeal the action taken on the code at the meeting of 1882, leaving the old code to stand as it was prior to that action. This comes up as an amendment to the by-laws. The third is a proposition to substitute the National Code for the new code. Then when representation in The Amer. Med. Asso. is regained, that the delegates of this Society be instructed to advocate such modifications in the National Code as may make it more liberal, or, if advisable, to urge its entire abolition.

All these propositions are amendments of the by-laws, and therefore require for adoption the "consent of two-thirds of the members present at an annual meeting."

They will probably come up in the order in which they were recorded, and that is as above given.

The first or no code proposition cannot possibly be carried without the new code advocates, and these latter must have a two-thirds majority present in order to do it. That, too, will be impossible, unless the old code advocates absent themselves from the meeting in greater numbers than ever before since the adoption of the new code. No code is the only rational and logical position of this movement, and it is therefore doubtless the ultimate aim of the movement, and may be brought forward every year until it is carried, but its success this year is improbable.

If the second proposition be carried, the third will fall or be modified. But if the second fails of a two-thirds vote, the third will almost necessarily fail also, although it has a somewhat different aim. Neither will be allowed to succeed if the new movement can prevent it.

The time for any farther discussion of any such propositions seems now to be past, and they will therefore probably be put upon their passage without the disagreeable wrangling and parliamentary tactics which have disgusted and disheartened so many conservative members, and probably kept them away from the late meetings. At least there is no use, nor any common sense, in any renewal of strife. The Society is now hopelessly split, and that upon a principle of honor,—or at least upon a basis which is assumed to be such by both sides of the split, because the revolutionists consider themselves as much bound in honor to destroy the old ethical basis of the Society's organization as the conservative element does to protect and defend it. And when a principle is involved, to yield is to submit. The vote, therefore, is to be for the final possession of the Society, and whichever party is defeated must withdraw and form new organizations if they desire to have them. Hence, as a matter of professional principle and honor, it seems to be the professional duty, as it should be the pride of every delegate and permanent member of the Society, to go to this meeting and record his name on one side or the other of this vital issue. Doubtless the Society will go on and flourish under whichever party gets the ascendancy, but so radical is the difference that it can never again flourish under both. The objects, means and methods being radically different, it would only paralyze its usefulness to attempt to blend them, and therefore this coming vote is to decide into which of two very different channels the Society will in future direct its usefulness. In either channel it may or may not do as much good as before, and if not, the new organizations that may grow out of the division may more than counterbalance the deficiency. As both sides cannot now occupy the same ground, the question simply is which shall hold it, and in this decision every man entitled to a vote on either side should see to it that his name is fairly recorded upon the side of his choice, after the full deliberation of two years. Whether his side succeeds or not is by no means the most important consideration, important though it be. The main point is to have his individual position clearly and unmistakably defined. The

vote should, and doubtless will be, by ayes and noes, since both sides should be equally determined to have a full and clear record.

According to the last volume of Transactions, the Society was then made up of 132 delegates and 254 permanent members. Of the latter about 7 are now dead. There are some known changes in the number of delegates, and about 12 counties entitled to about 15 delegates have not been heard from.

Enough is, however, known in the canvass of the Organization to Uphold the National Code of Ethics to show that there is a decided majority in favor of the National Code. How large this majority is, or whether it will reach the necessary two-thirds, must remain in doubt until the vote is taken. But this is not the worst element in the uncertainty. The whole history of the movement up to the present moment has abundantly shown that while the revolutionists bring out somewhere near their full vote every time they know or suppose it to be needed or useful, the defensive side cannot, or do not, get theirs out in the same proportion or anything like it. At the last annual meeting, and in many of the constituent organizations before and since that meeting, the conservative or defensive side has allowed the issue to go by default. There have always been enough to turn the scale the right way, and to keep it there, but they will not go to vote. Had this conservative element been in the habit of attending the annual meetings in proportion to their aggregate number, the new code never could have obtained the two-thirds vote necessary to its adoption; and at no time since its adoption could such a vote have been obtained. But having been adopted in a meeting of 70 votes, the necessity for two-thirds was thus most skillfully transferred to the other side of the issue, so that when the issue for a repeal came up in a meeting of 204 votes, even a majority for the repeal was not obtained. At any time throughout the controversy a vote by counties would have reinstated the Society on its former basis. But although the Society is a representative body, such a vote would never be permitted, and in several instances counties were carried against their decisions. Such will always be the results where men will not take the trouble to vote, and thus majorities are rendered powerless and useless.

If the conservative and defensive part of the profession does not come out more manfully this year than last, to express its will or wish upon this issue, the supineness will be equivalent to an abandonment of the case, for then a two-thirds vote cannot be had, because no supineness on the part of the opposition is supposable. Then in

abandoning the issue, this part of the profession which stays at home, and remains uncommitted, puts itself in the position of either abandoning a principle of honor or of abandoning its only general or State organization, and thus allowing this organization to be used against its principles and interests. Not only this, but it places itself in that equivocal no-man's-land which such an element should be most anxious to avoid. The natural desire of every man is to be on what he considers the right side of every important issue of moral principle which directly affects him, and hence it is hard to see how he can submit to be on no side, or how he can consent to belong to a profession and refuse his share in deciding its public issues. His vote being once fairly recorded on the final issue, he may then,—but only then,—rest quietly at home.

In *The Medical Record* of Nov. 24th, 1883, p. 578, occurs one of those dangerous little editorials which possibly may need a little examination to avoid the harm of the injurious conclusions to which it misleads, and to show the ethical and moral state of mind of the writer of it,—whether or no he needs any code or moral law more than he now has.

The entire article is as follows:—

"We have received from 'The Central Organization of the New York State Medical Association to Uphold the National Code of Ethics" a pamphlet showing the vote, or non-vote of the members of the medical profession in this State on the Code of Ethics. The figures given are: National Code, 2,424; New Code, 943; no Code, 210; unclassified, 31; uncommitted, 1,611; total, 5,219. In New York county out of about 1,800 names, 764 are placed among the National Code party. We recognize here, however, many names of those who voted for Dr. Vander Poel at the County Society. Despite all efforts, a majority for the National Code has not been secured. Many of those who have given their names would, we believe, prefer to be among the uncommitted. We ask now, will a minority of the profession continue to try and force upon the majority the enactment of a disciplinary by-law which accomplished nothing but to lower the physician in public esteem?"

With the figures before him, the following facts must have been known when the above was written. Of the 5,219 whose names could be obtained from all sources, 3,608 voted, but 31 of these votes were too indefinite to be fairly counted on either side of the

issue voted upon, thus leaving the total vote 3,577, while 1,611 made no reply,—were not heard from at all, and therefore declined to vote at all. Of the 3,577,—or say 3,608,—who did vote 2,424 voted for the National Code, and 1,184 voted against it. Majority in the State for the National Code, 1,240, the National Code having 19 votes over two-thirds of the total votes,—or 19 votes more than two to one of the combined opposition.

It is manifestly unfair to count persons as voting who do not vote,—but what shall be said of the ethics,—the morality, or the truthfulness of counting them all on one side, yet the *Record* does this thing in representing the National Code side in the minority. If the "non-vote," as the *Record* calls the 1,611, is to be estimated at all in making up the voice of the profession, let it be ranged on the ratio of the vote actually cast. Then it would divide into 1,082 for the National Code and 529 against it, and the vote of the State would stand by estimate, for the National Code, 3,506; against it, 1,713. That is, the non-voters do not, nor can they affect the numerical relations of those who do vote, and of these latter two voted for the National Code to one against it.

Next take the *Record* on New York county. There are 1,707 names in the pamphlet, of which 771 are for the National Code and 491 against it, with 445 non-voters. These 445 who declined to vote must be added here also to the 491, in order to make the majority claimed. But the actual vote cast is here again more than two to one for the National Code. But here the *Record*, being at home, recognizes names on the National Code list who voted against the National Code candidate when the direct issue was brought in the County Society. The vote in the County Society was by ballot, yet still the *Record* may know how the names voted, but it is most injurious to those persons to accuse them of voting one way by their signatures on paper, and another way on a secret ballot. Such men being beyond moral restraints should not be on the side of the National Code. Again the *Record* believes that names are on that same list who would prefer to be among the uncommitted. This is another very injurious inferential accusation that should be very surely true before it is used against any honorable man, and especially against any who believe in the wholesome restraints of law and order when voting for them, and against the abrogation of a law and the substitution of a disorderly go-as-you-please policy.

Finally, the *Record* reaches the climax of misstatement when, after stating the majority of two to one to be a minority, it asks in

child-like simplicity, how long this minority will try to force upon the majority the enactment of a disciplinary by-law. Did not the *Record* know well that this majority, whom it puts in minority, was seeking to uphold and defend a by-law, which its party had destroyed by means which have hopelessly split the profession of this State into fragments which never can be reunited;—a party which successful here is restless now until it carries dissension throughout the nation.

This same "pamphlet" of the *Record*,—a "Catalogue of Members of The Medical Profession in the State of New York, showing their vote on the Codes of Ethics," which is now being revised and corrected,—gives the following statistics of the Kings County medical profession :

Total number who voted, 384. Of these 248 voted for the National Code ; 99 for the new Code; 34 for no Code, and 3 who could not be classified ; making 248 for and 136 against the National Code; and 123 who declined to vote at all—that is, were not heard from. This is not quite two for the National Code to one against it, but is a majority of 112 out of 384 votes, and yet in the County Medical Society the opposition has ruled with a strong and unsparing hand, and to all appearances will now have the Society to themselves, because it is acriminous, disagreeable, and perhaps would be useless to oppose such a wary, intense and eager minority. The profession is split upon a vital issue of principle, and the minority will hold the Society.

One of the most remarkable features of this Catalogue is the number of names, not only in these two counties, but throughout the State, who refuse to vote on either side of this issue,—1,611 out of 5,219, or nearly 31 p. c. It would be very unfair to this list of names to suppose that they who compose it have no choice, nor an opinion upon a vital issue of principle in professional conduct, and therefore on professional character. Many names are to be found on that list, by any one who knows even a little of the profession of this State, who when men are ranging themselves on one side or the other of a professional issue of such importance, have given the rational expectation, by lives and characters, that they would be found prompt and decided for one side or the other. Discussion was certainly full, even to excess, on both sides before a vote was asked for, and yet but about 69 p. c. of the catalogued profession

could be got to vote. Over 67 p. c. of those who voted and nearly 47 p.c. of the Catalogue voted for the National Code, but it is the 31 p.c. of the Catalogue who, though directly appealed to, and often appealed to more than once, yet refused to place themselves on either side, but persistently refused to have a voice in a profession to which they belong, when it would cost them only the effort of their signatures,—who must excite the wonder, and cause profound regret to both sides of the issue.

Another remarkable feature of the controversy is the small effect of the arguments and facts elicited on both sides of the discussion. From the first outbreak it was plain that those who sought to change the basis of professional conduct and character meant to use the means necessary to carry their point irrespective of consequences. They would not split and disorganize the profession if the profession would change over to their views. But if the profession remained steadfast and true to its established organic law, why then the profession must take the consequences thus brought upon itself, and be split up and disorganized. This writer knows of no single instance of any one changing his position from one side to the other through the reasoning or arguments brought out. Those who defended the old ground, so long occupied, could say little that had not long been known. While those who attacked the old ground have throughout depended more on aggressive tactics than on established principle or argument. While the defence would rest on its principles and stay quietly at home, the attacking party attended meetings in full force, and lost no opportunities of placing themselves on the offensive. Fighting rather than logic has been their policy, and so successful has it proved as a policy, and so distasteful is acrimony and dissension to a large proportion of the profession, that the defenders of the National Code, though in large majority in the State, are willing, through all that has been written and all that has been done, to lie supine and see their organizations captured one after another, and themselves left unorganized. One important thing may be inferred from this, and that is that they do not set a high value on the present organizations. If this be so they may now, with the discontented portions split off, reorganize for better and more peaceful work.

In New York county the work of reorganization has already begun. A New York County Medical Association has been formed,

a full set of officers elected, and a good set of by-laws adopted; and a little good scientific work has already been done. The promoters of this Association seem to be in great earnest to establish quietly and unostentatiously a nucleus for that part of the profession which cannot abandon its principles nor give up its relations with the profession of the nation at large. As the disheartening effect of the recent defeat in the County Society wears off, and the taste for the discussion of practical professional work reasserts itself, this Association will undoubtedly thrive and become the pioneer of others in other counties.

The very decisive victory of the New Code party in the N. Y. County Society seems to have had a paralyzing effect. Naturally it should have started the Society on a new and vigorous life, with plenty of practical professional work and plenty of hands to take part in it. Heretofore the meetings have been small, and the proceedings of a rather perfunctory, routine character. But the annual meeting reformed all this, and was a tremendous success. At that one meeting 81 new members were made, and 599 ballots were cast. At the next succeeding meeting the addresses of the retiring president and the new president were made, and other matters of interest were on hand, but the meeting was not so large. Just about 16 persons were present, and of these 4 were reporters, the two presidents, making two others of the 16.

APPROXIMATE ESTIMATION OF UREA IN URINE.

Urea is almost universally regarded as a uniform and constant product of the metamorphosis of living animal tissue, and its proportion as being a measure of the work done, or the force applied, in the vital processes of the animal organism. It is either formed in the tissues and washed out by the blood, or is formed in the blood with the changes which occur in that fluid in the tissues. Its characteristic element is nitrogen, and with the exceptions of uric acid and creatinine, it is the only nitrogenized product of tissue changes, or wear and tear in the healthy animal economy. Uric acid and creatinine are normally present only in very small quantity in proportion to urea, and both may be regarded, perhaps, simply as traces of incomplete urea, or of the elements of urea which have

escaped full oxidation in the metamorphosis of tissues, by forming other combinations before their conversion into urea is complete. Hence urea becomes the measure of the vital forces of the economy, or of the work done through the vital processes; and it seems to be less the excrementitious or waste product of the food taken, than of the tissues previously formed from the supplies of food. It is entirely excrementitious, and, found in the blood, it has to be eliminated at the rate of its production if a normal condition is to be maintained. If not so eliminated, it accumulates and becomes toxic in proportion to the rate and amount of the accumulation. Its only, or almost its only way of elimination is by the kidneys into the urine, and if the kidneys do not eliminate it as fast as it is produced, it accumulates in the blood and constitutes uræmia, when it becomes proportionately absent from the urine. The presence of albumen in the urine,—or of substances which answer to the ordinary tests like albumen,—is often proportionate to the accumulation of urea in the blood. But this relation is by no means constant, for cases are rapidly multiplying wherein uræmic explosions occur without any premonitory albumenuria.*

Dalton's Human Physiology supplies the data for the following deductions: A man of average size, say 65 kilogrammes or 143 pounds weight, in normal condition, has in the total quantity of his blood an average amount of about 1.3 grammes or 20 grains of urea, and it may be inferred that the kidneys, by varying the rate of elimination, keep the proportion in the blood at somewhere about this total quantity. But in disease of the kidneys when the elimination is obstructed, the quantity has been observed to be more than nine times as much, or say 12 grammes or 185 grains.

This seems a very small quantity in a total of 8,127 grammes or 18 pounds of blood, but it is constantly eliminated at the rate of supply: and the total excretion for the twenty-four hours in a man of the same weight is about 31 grammes or 478 grains,—that is, about 24 times the quantity present in the blood, on an average, at any one time,—or in other words, the total mass of blood continuously frees itself from its 20 grains of urea, and is resupplied from the tissue waste, about once an hour. Hence an obstruction of the kidneys for a single hour would double the quantity of urea in the blood; or a partial obstruction of one twenty-fourth part of the normal rate of excretion would double the amount of urea in the blood in twenty-four hours; and with this same small degree of obstruction the quantity in the blood would so accumulate that at the

end of eight days about 12 grammes or 185 grains, or the largest amount mentioned by Dr. Dalton would be present. Then as urea in the blood beyond the normal amount is toxic, and is only tolerated, even by habit, up to a certain variable point when an explosion of some kind occurs, it is evident that the kidneys must be stimulated to act, or the aliment and the exercise must be controlled to diminish the production of urea—one or both, if the damaging explosion and its consequences are to be avoided.

There is hardly anything in the domain of medicine more rational and clear and simple than the treatment of uræmia, nor any more likely to yield good results if begun early enough. But the difficulty is to recognize the uræmia and ascertain its cause before the toxic impression becomes too profound. To reduce or suspend the nitrogenous elements of nutrition,—to diminish tissue-waste,—to stimulate the skin and mucous membranes to increased activity whereby to depurate the blood, and to treat the kidneys in accordance with the kind of obstruction present,—all before the urea has accumulated to a serious extent, is a perfectly plain course. But to recognize the accumulation early enough to know the best time to begin such a course is much more difficult.

It is from such considerations as these that the necessity arises of knowing the rate at which urea is excreted in many, if not in most diseased conditions, and also in some conditions of apparent health; and any method by which this rate can be more easily ascertained in the future than in the past, must be of sufficient importance to warrant publication.

The excellent authority of Dalton gives the average normal excretion of urine in man as about 1,200 c.c., or 40 fluidounces daily; and the average proportion of urea in such urine, as 2.62 p.c. This would give a total daily excretion of about 31.5 grammes, or 487 grains. But the same authority gives on another page 35 grammes, or 540 grains, for a healthy man of medium size.

The proportion of urea in urine differs largely in different conditions of rest and exercise, and in different parts of the 24 hours. In some of the 80 odd determinations made for this paper the writer found the proportion late in the evening of a busy day about double what it was at about the same hour of the morning after a night and day of comparative rest. The proportion also varies very much in different persons under apparently similar conditions, except for the habit of being large eaters or small eaters.

It is, therefore, probable that each individual has his own rate of formation and elimination of urea in health, a circumstance that should not be overlooked in examinations of the rate in disease.

Many processes are in use for determining the proportion of urea in urine, each one having some advantages and disadvantages, and no one being equally applicable to all cases of abnormal conditions of urine; but it is a great drawback that all are troublesome and complicated, and appropriate only to the expert chemist, and hardly practicable to physicians and pharmacists; while the physician is the only person who needs them, and who in an active practice may need them two or three times a week. An attempt is made in this paper to present a simple apparatus and method, which, though not very accurate nor free from objections, is, with a very little practice, easily managed either by physician, pharmacist or trained nurse.

Of all the processes in use the hypobromite of sodium process originally proposed, so far as the use of an hypobromite is concerned, by W. Knop, prior to 1870. This process was improved by Messrs. W. J. Russell, Ph.D., F. R. S., and S. H. West, B. A. (Ch. Ch. Oxon.), in a paper published in the *Journal of the Chemical Society of London* for 1874, p. 749. Many years before Davy had shown that the hypochlorites of calcium and sodium would decompose the urea of urine with liberation of all the nitrogen in gaseous form, and that the gas could be measured and calculated back to the quantity of urea, which it accurately represented. The apparatus was, however, complicated and expensive, and the manipulation troublesome and tedious, and therefore the process was confined to expert hands and well-furnished laboratories. The hypobromite process was more simple and more accurate, and the paper introducing it gave many valuable points in connection with the application of the principle, but left the process still confined to the domain of the skilled chemist and out of reach of the daily practitioner.

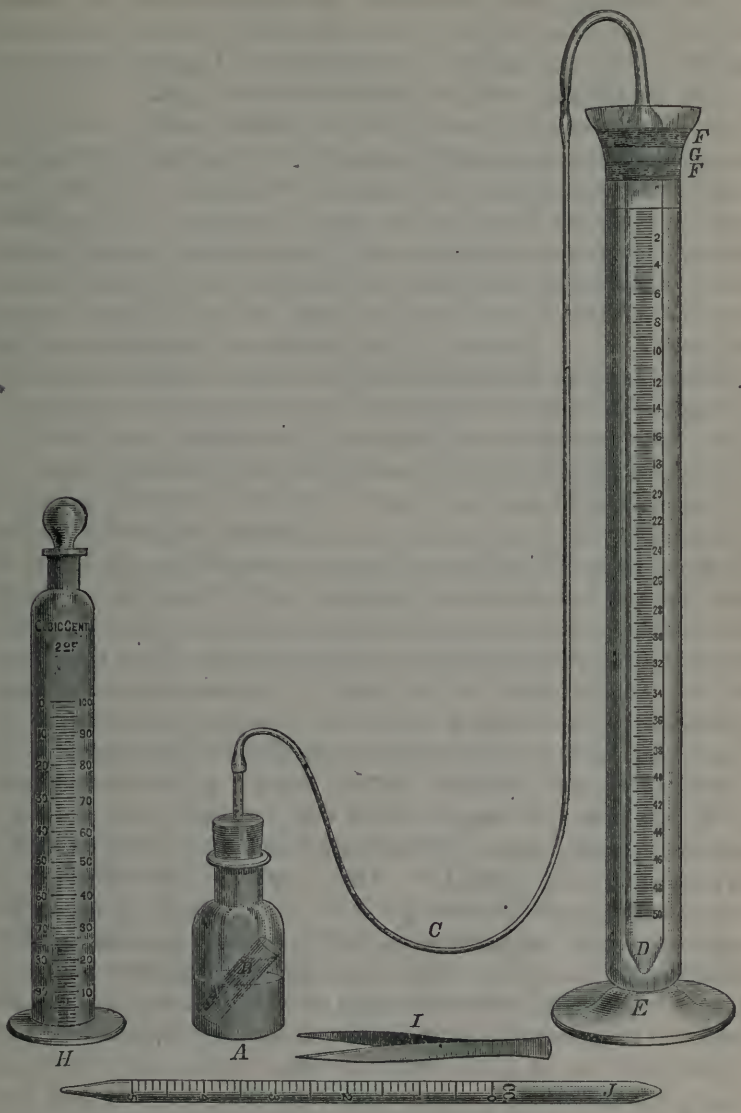
In 1877 Dr. G. Noel simplified the apparatus and process very much, and his apparatus is figured and described in "A Guide to the Practical Examination of Urine," by James Tyson, M. D., Phila., 1878, at page 88. In 1878 Dr. Maurice Perkins, of Schenectady, N. Y., in the Transactions of the Med. Society of the State of New York, p. 142, simplified the apparatus a little farther, and in 1879 the present writer in the Transactions of that year, at p. 78, aided a little, perhaps, in bringing both the apparatus and process to its simplest form, and still it seems to have been out of the reach of

the general physician and nurse, though the need of it continued to increase rapidly as habits of close observation of the sick were cultivated in the profession.

This hypobromite process has for several years past been justly considered as the standard process, and in practical hands it certainly leaves little to be desired in point of accuracy of results; the only objection to it is that it is out of the reach of the large class of practicing physicians who are just those who most need the results, and who could well afford to dispense with a part of its great accuracy if a more simple and easy method could be devised. It must, however, still remain to be the standard process, and it must continue to be resorted to when very accurate results are required; and therefore it cannot be omitted from consideration here, especially as it is the basis of the modification of it to be afterward described.

The opposite illustration shows the entire apparatus in readiness to commence a determination.

A is a common wide-mouthed vial of about 60 c.c. or 2 fluid-ounces capacity, fitted with a tight cork, perforated, and furnished with a short small glass tube. Inside of this is shown B, the urine jar, of about 5 c.c. or 80 minims capacity. C is a piece of rubber tubing of about 3 m.m., or one-eighth inch bore and about 70 c. m. or 28 inches long. D is a common 50 c.c. pipette, graduated in tenths, the suction end of which is bent over and drawn down in the lamp so as to allow the rubber tubing to fit closely onto it. The length of the graduated part is about 38 c.m. or 15 inches. This is suspended in the centre of a tall hydrometer jar E, whose internal diameter is about 1.25 c.m. or $\frac{1}{2}$ inch greater than the external diameter of the pipette D. The pipette is held in the centre of the jar, but free to be moved up and down easily, by means of two sections of perforated cork fitting the cylinder tightly, but notched at the edges for the free passage of water and air, and through which the pipette passes very loosely. Between these corks is a disk of rubber, G, fitting the jar loosely, but perforated to fit over the pipette just tightly enough to hold it in any position in which it may be put, and just loosely enough to allow it to be moved up and down easily. H is a 50 c.c. graduated glass-stoppered cylinder, in which to mix the elements of the hypobromite of sodium. I is a pair of forceps, with which to lower the urine jar, when charged, into the vial A. And finally, J is a 5 c.c. graduated pipette for measuring the urine. This and the 50 c.c. pipette should agree closely in their graduation.



APPARATUS FOR THE DETERMINATION OF UREA IN URINE.

The jar is filled with water until the surfaces inside and outside the pipette are on the same level, and coincident with the 0 mark of the graduation, one end of the rubber tube being in place on the end of the pipette, and the other end free and open.

The hypobromite solution should be freshly made for each day's use, though not necessarily for each determination. The mixing cylinder H holds enough for three determinations. The soda solution is made by dissolving 30 parts of caustic soda in sufficient water to make the whole measure 100 parts, and allowing the solution to settle for 24 or 48 hours. Of the clear or nearly clear solution 47.5 c.c. is measured off in the mixing cylinder H, and to this is added 2.5 c.c. of bromine. The liquids are agitated gently and combine in a few seconds, forming a yellow solution, which, if to be used at once, must be cooled to the room temperature in a water-bath. Bromine occurs in commerce in one-ounce vials packed in a tin can, and generally both case and vial are difficult to open. If the stoppering of the vial be good, it is often impossible to get the stopper out, and if the neck has to be broken off, great care must be taken to avoid spilling the bromine and inhaling the vapor, for it is quite irritant to the air passages. The whole apparatus and contents being at the room temperature, 15 c.c., or half a fluidounce of the hypobromite solution is put into vial A. Then 4 c.c., or 64 minims of the urine to be tested is carefully and accurately measured into the urine jar B, and by means of the forceps I the jar is set into the hypobromite solution in the vial A in the position shown in the cut. If the stopper of A be of ordinary cork, it is soaked in water and put into its place wet. If it be of rubber, it is put in dry. Then the free end of the rubber tube C is slipped onto the glass tube of the stopper. The levels of the water in the pipette D and jar E are to be carefully adjusted to the 0 mark of the graduation, and then the apparatus is ready. Vial A is then inclined so that the urine and hypobromite solution mix, when a brisk effervescence at once begins, and the escaping nitrogen displaces the water in the pipette D. This is now to be raised in the jar so as to keep the water inside at or above the water outside until the reaction slackens. Then the vial A is to be agitated gently but thoroughly, without allowing any liquid to enter the rubber tube, until all reaction ceases, and the water inside the pipette D no longer falls. Considerable warmth is generated in vial A by the reaction, and the nitrogen passes over warmed and expanded. Time must therefore now be allowed for the whole

apparatus to return to the temperature of the room, before the result can be read off. This time may be shortened to about 10 minutes by putting the vial A into a water-bath at the room temperature. The pipette is then raised or lowered until the water inside and outside are accurately on the same level, and then the graduation is read off and the volume of the nitrogen is accurately noted. Each c.c. of nitrogen is equal to ·0027 gram. of urea.

Suppose the volume of nitrogen in the pipette measured 40 c.c., then the amount of urea in the 4 c.c. of urine would be (40×·0027 =) ·108 gramme. Then if 4.000 c.c. yield ·108 gramme, 1·000 c.c. would yield ·027 gramme. Then, as 1000 : ·027 : : 100 : 2.7 which is the percentage of urea in this supposed urine.

Then suppose this urine had been taken from the mixed product of twenty-four hours' excretion, which measured 1,200 c.c. or grammes; thus if 100 yielded 2.7, 1,200 would yield 12 times 2.7 or 32.4, and therefore the individual had passed 32.4 grammes of urea in the twenty-four hours.

Russell and West, in their paper before referred to, state that with their apparatus and management in the use of hypobromite of sodium, the uric acid of the urates and the creatinine are but partially and slightly decomposed by it, and yet their results were about 8 p.c. of nitrogen too low, even when operating on known quantities of pure urea.

With the above apparatus and management, however, this writer has always obtained much closer results. For example, in recent trials with an accurately made solution of fairly pure and dry urea of a strength of 2.5 p.c. the following results were obtained, namely: 2.43, 2.46 and 2.46 p.c., and these are quite within the probable purity of the urea.

E. W. Davy, in 1854, described, in the Phil. Mag. [4] vii. p. 385, a method of decomposing urea by hypochlorites of calcium or sodium, and of collecting and measuring the nitrogen. But after his process had been variously modified by those who followed him, it seems to have been superseded by the hypobromite process of W. Knop.

Of late some one,—but the writer cannot ascertain who it was,—has returned to the hypochlorites of Davy, and proposed the use of the Solution of Chlorinated Soda of the U. S. Pharmacopœia for the decomposition. This form of Labarraque's solution is a mixture of the solutions of hypochlorite of sodium, chloride of sodium and carbonate of sodium, of which the hypochlorite is in much the

largest proportion. Adopting the idea of using this solution for decomposing urea, the writer made an investigation of the subject, and, through many difficulties, ascertained the conditions under which it may be used in the above described apparatus. When urea is decomposed by any of these hypochlorites or hypobromites, it is converted into nitrogen, carbonic anhydride and water, and an excess of free caustic alkali has been thought to be necessary in order to absorb and fix the carbonic anhydride. Otherwise it would pass over with the nitrogen, and prevent the measurement of that gas.

But there is no free alkali present in the Solution of Chlorinated Soda to effect this purpose, and when the solution is used in only a moderate excess for the decomposition, the reaction is prompt and rapid, but considerable quantities of carbonic anhydride go over with the nitrogen, and vitiate the results. The addition of solution of caustic soda to the solution does not effect the desired purpose, but simply retards the reaction and makes the decomposition only partial. But if a large excess of the chlorinated soda solution be used the decomposition takes place promptly, yet no carbonic anhydride passes over. The reason why the carbonic acid gas is liberated with the nitrogen when but a moderate excess is used, and is not liberated when a great excess is used, is probably to be found in the fact that the Officinal U. S. P. Solution of Chlorinated Soda contains a considerable proportion of carbonate of sodium ; and when this is present in sufficient amount to absorb all the carbonic anhydride or acid in being converted into a bicarbonate, there is none to go over with the nitrogen. Whoever may have applied this solution to this use heretofore must have either obtained very confusing results, or else must have discovered this necessity for a great excess ; yet the writer has sought in vain for any published information on the subject of the use of the solution. When the solution is made either by the formula of the U. S. P. of 1870, or the changed formula of 1880, 10 c.c. of the solution to 1 c.c. of urine gives a sufficient excess. That is, 40 c.c. or $1\frac{1}{3}$ fluidounces to the prescribed 4 c.c. of the urine. But if only 30 c.c. be used much carbonic acid gas will pass over and make the results read much too high.

Duplicate trials were made in the above apparatus with known solutions of urea, and with numerous specimens of urine, using the hypobromite of sodium for one set, and the Solution of Chlorinated Soda for the other, with the general effect of yielding practically the same result. In 18 trials there was only one difference that

amounted to 1.7 c.c. of gas, and all the others were so much nearer than this as to cause a suspicion of some slight accident, such as liquid in the rubber gas tube. Yet this difference of 1.7 c.c. is only ·1168 p.c.

It seems therefore very plain that the use of this solution instead of the hypobromite is a very important improvement in the process, not only in simplifying and shortening it, but in bringing it within the reach of a great many more operators. In dispensing with the troublesome bromine and caustic soda and the mixing cylinder, and substituting an inexpensive liquid always easily accessible, and which keeps indefinitely, certainly very much is gained for the process in the direction of its general application, and yet it is by no means easy to get a large pipette and hydrometer jar that will answer the purpose, and when obtained they are costly, easily broken when not in expert hands, and the measurement of a gas even by means so convenient is not very easy. Beside this, the apparatus is large and not easily carried with safety without skillful packing.

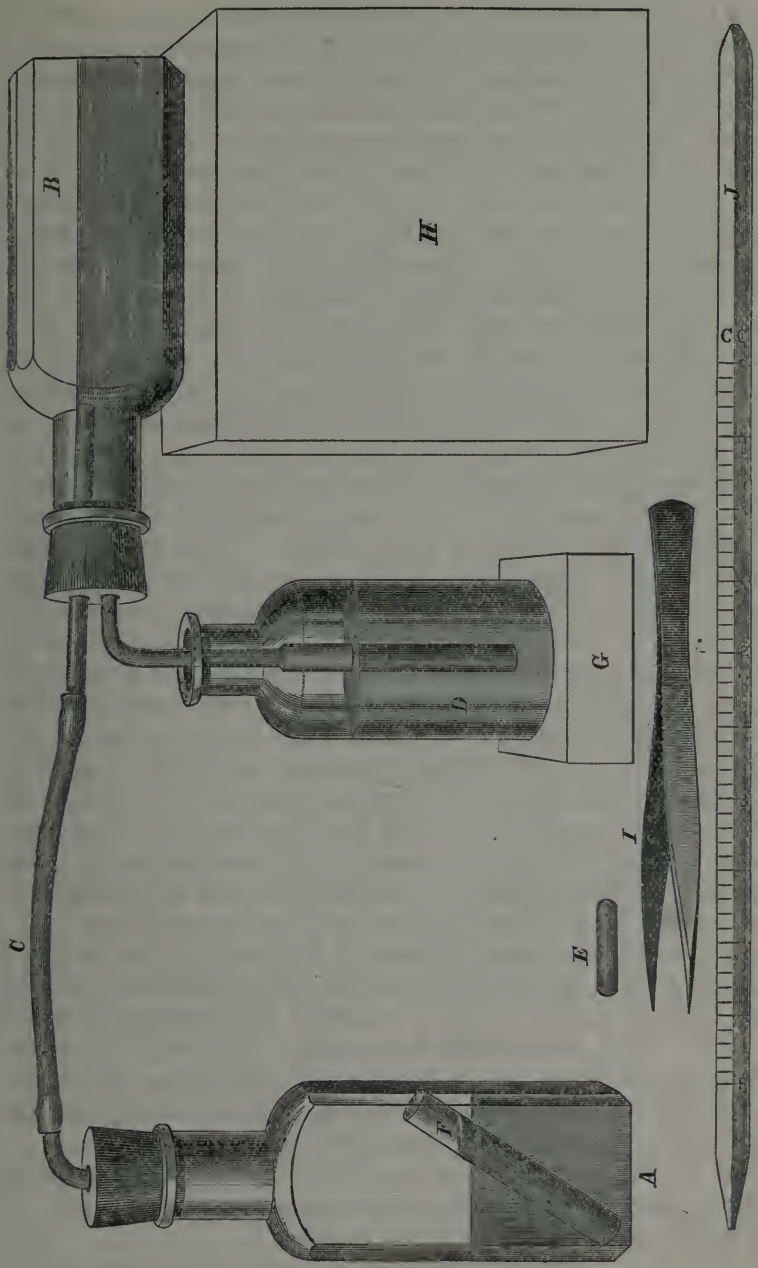
After determining the conditions for the successful use of the Chlorinated Soda Solution, the writer applied to the process a device often before used by him for the approximate measurement of gases and found that it answered well, and permitted such a modification of the apparatus as to do away with most of the objections to it, thus adapting it far better to easy every-day use by any attendant of the sick who can use a thermometer or urinometer. The device alluded to is, instead of measuring the gas, to measure the water displaced by it, as the volumes of the two are practically the same. This is much more simple and easy, and may be done with the same pipette that is used for the urine, or may even be roughly done with a common graduated measure. It is not pretended that any very great degree of chemical accuracy is attained in this way, and it is claimed that such a degree of accuracy is not needed in every day practice,—or at least that it is not at all essential to the practical utility of the results. With moderate care the readings will generally be within 1 c.c. of the true quantity, and this is within ·07 p.c. in the proportion of urea found.

Having first shown the conditions under which the Solution of Chlorinated Soda may be substituted for the alkaline hypobromite solution, and that the displaced water may be measured instead of the gas which displaces it, it only remains to show as clearly and as much in detail as possible the very inexpensive and simple appa-

ratus and process by which the practically useful results may be obtained. It will easily be seen that any one can make this apparatus for himself, with the exception, perhaps, of the graduated pipette. But if skillful enough to use a common minim measure with tolerable accuracy even the pipette may be dispensed with, and yet fairly useful comparative results be obtained. Then the entire material for the apparatus is easily accessible to any person in any part of the country where medicines are used, and where nursing bottles, etc., will supply the needed glass and rubber tubing. Certain kinds of vials, corks, etc., are better than other kinds, and it is well to have the apparatus in a good form and condition, kept together in a box, with printed directions on the lid to recall the steps of the process to those who apply it, at the time of the application, and the writer puts up such a set of the apparatus at a cost which to the physician should not exceed $1.50 to $2.00. But such a set is not at all necessary to the very best attainable results, and is only a convenience to those who choose to buy rather than to make for themselves. By the aid of the cut given any physician, pharmacist or nurse should make the apparatus in an hour or two, and he or she who has the intelligence to make it best will always use it best.

Description of Apparatus and Mode of Using It.

The apparatus consists of two four-ounce wide-mouth vials, two good corks which fit the mouths of the vials accurately, two short, small, glass tubes bent at right angles, and one straight tube, all three glazed in the lamp at the ends so that rubber tubing slips onto them easily and tightly;—two pieces of pure rubber tubing of about 3 m.m. or $\frac{1}{8}$ inch bore;—a small glass or wooden plug of proper size to stopper the rubber tubing;—a narrow glass jar or homœopathic vial which will pass through the neck of one of the vials, and of about 5 c.c., or 80 minims capacity;—a pair of small forceps with which to pass the jar into the vial, and lastly, a graduated pipette of 5 c.c., or 80 minims capacity. The other essentials which every physician and pharmacist has always at hand, are a block, or two or three books on which to lay one of the bottles;—a common two-ounce vial and a block or book to set it on, and a two-ounce graduated measure. And for rough work a common minim measure may supply the place of the more accurate graduated pipette.



APPARATUS FOR THE APPROXIMATE ESTIMATION OF UREA IN URINE.

All these, excepting the graduated measure, are shown a quarter of the full size in the illustration, and the illustration represents the apparatus at the end of a determination while standing to allow of adjustment of temperatures before measuring the result. A and B are the two four-ounce wide-mouth vials, one of which, at least, should be square in order to avoid rolling when laid on its side. Those shown in the cut are the ordinary bottles in which pills are put up, and they answer very well and are easily accessible everywhere. Although ordinary corks are suitable, rubber corks are better and more durable. If ordinary corks be used, they should be soaked in water before using, and be put in wet. If rubber corks be used, they should be put in dry, the mouth of the vial being also dry, otherwise they are difficult to keep in place. One cork has two perforations and the other has one, and these are occupied by short glass tubes as shown. C is a piece of rubber tubing about 20 c.m. or 8 inches long, which connects the two vials, for the passage of the gas. D is the receiving vial for the displaced water, and a piece of rubber tubing passes down into this to conduct the water into it, and long enough to be below the surface of the water at the end of the operation, even though the water be small in quantity. E is the little plug used to stop the end of this short rubber tube before the operation is commenced. F is the urine jar which holds its charge from contact with the decomposing liquid while the apparatus is being charged and adjusted. G is the block about 25 m.m. or 1 inch thick to support the receiving vial in place during the operation. H is the block or books for supporting the vial in which the gas displaces the water. I is the forceps for lowering the urine jar into the vial where the decomposition is to be effected ;—and J is the graduated pipette for measuring the urine and the displaced water.

In using the apparatus, put into vial A 40 c.c. or $1\frac{1}{3}$ fluidounces of officinal U. S. P. Solution of Chlorinated Soda. Measure accurately into the urine jar F, 4 c.c. or 64 minims of the urine, and by means of the forceps I, or some other device, as a loop of thread, place the charged urine jar in the solution in vial A in the position shown in the cut, and put the stopper securely in place, having the long rubber tube slipped onto the short glass tube.

Fill vial B nearly full of water of the temperature of the room. Put the short rubber tube on the bent glass tube of the stopper of B, and then put the stopper firmly in place.

Then holding vial B, thus stoppered, in the right hand, with the forefinger over the end of the straight glass tube, incline the vial toward the bent glass tube until that and the short rubber tube on it, fill with water. When filled, stop the flow by closing the end of the straight tube with the finger, and with the left hand put the little stopper E into the end of the short rubber tube while this tube is full of water.

Then lay the vial B on its side on the support, as shown, and slip the free end of the long rubber tube C onto the straight glass tube of the stopper of B thus connecting A and B.

Put a piece of waste paper under the end of the short rubber tube, and then take out the little stopper E. A few drops of water will usually escape, but if the apparatus be tight, and if the temperature of the apparatus and the room be the same, no more water will run out, nor will any air enter.

A common two-ounce vial D, or any other similar vessel, is to be used for receiving the displaced water. Rinse it out and drain it for a moment so as to leave the inner surfaces wet as they will be left when it is emptied for measurement of the water, and then put it in its place under the short rubber tube, as shown, and the apparatus is then ready for the process.

Incline the vial A until the urine and the solution mix, and agitate the mixture gently sidewise until the effervescence ceases, being sure that a full interchange of liquids between the jar and vial is effected. When the effervescence is at an end, and no farther movement of gas into B occurs upon pretty vigorous agitation, let the apparatus stand a quarter or half hour to regain the room temperature. The time required to equalize the temperature may be shortened to about ten minutes by immersing vial A in a bath of water at the room temperature. During this cooling a little water will pass back from D into B, and from B into A, and when this movement is at an end, the water in D is to be carefully measured with the pipette J into another vessel, from which the measurement can be verified if necessary.

In measuring this displaced water from D, 5 c.c. at a time, care must be taken in the counting. At the end there will almost always be some fraction of 5 c.c. to measure, and this is best done in the following way:

Reverse the pipette, and by suction at the point or small end draw in water from any source of supply, to half fill the pipette. Then with the finger on the small end, let the water run out until

the 0 mark of the graduation is exactly reached. Then the upper or blank end of the pipette, from the 0 mark upward, will be exactly filled. Allow this water to run into that which remains in D, and be thus added to it. Then draw the whole into the pipette, stop the upper end quickly with the finger so as to keep it all in, and then reverse the pipette with the upper end stopped, and read off the quantity by the graduations,—the water which occupies the ungraduated part being that which has been added, and therefore not to be counted.

Each c.c. of this displaced water is equal to a c.c. of the nitrogen which displaced it;—and each c.c. of nitrogen represents ·0027 gramme of urea. Therefore the number of c.c. of water represents the number of times ·0027 gramme of urea contained in 4 c.c. of the urine. But it is more simple and easy to obtain the percentage from 1 c.c. of urine, and therefore the number of c.c. of displaced water is divided by 4. Then this number being multiplied by ·0027 gives the percentage of urea in the urine.

For example, suppose the displaced water from 4 c.c. of urine be 36 c.c. This divided by 4 gives 9 c.c. for each 1 c.c. of urine. Then 9 times ·0027 is ·0243. Then, as this quantity of urea comes from 1.000 c.c. or 1.000 gramme, it must be multiplied by 100 in order to give percentage, and this is the same thing as moving the decimal point two places to the right, or between the 2 and the 4. Hence the urine contained 2.43 p.c. of urea.

If minims and grains be used instead of cubic centimetres and grammes, the calculation is precisely the same, only less simple. The 64 minims of the same urine would give 584.27 minims of displaced water.

Each minim of displaced water represents ·0027 grain of urea. Therefore the 584.27 multiplied by ·0027 grain gives 1.577529 as the total urea from 64 minims of urine. Then the 1.5775 divided by the 64 minims gives ·0246+grain of urea for each minim, and this multiplied by 100 gives 2.46 p.c. urea for the urine.

To apply these figures to the total urine of the 24 hours, the whole is measured in c.c. or in fluidounces. If in fluidounces it is better to reduce this to minims by multiplying by 480, or the number of minims in the fluidounce.

Suppose the urine for the 24 hours be 1,200 c.c. or 40 fluidounces. If 1,200 c.c., then 2.43 p.c. of this quantity is (1,200×2.43=2916.00 ÷100=) 29.16 grammes as the total excretion of urea for the 24 hours. If 40 fluidounces or (40×480=) 19,200 minims, then 2.46 p. c.

of this quantity is (19,200×2.46=47232.00÷100=) 472.32 grains as the total excretion for the 24 hours.

The use of the ordinary graduated measures of the physician and pharmacist in a process like this, inaccurate as they are known to be, and read by broad surfaces to the marks,—is only a close way of guessing at the quantities involved. But as they are the only measures that are always accessible, they will doubtless be used, and all that can be said of the results is that perhaps they are better than none. And, that when any one has learned to use the apparatus in any such rude way, the smallest appetite for accuracy will soon lead him to better methods of measurement.

With a good supply of water at the room temperature, the whole process does not require half an hour, including the setting up and charging the apparatus.

It may be as well to note, in conclusion, that any kind of solution of chlorinated soda will not answer for this process no more than for medicinal uses, as the markets are all supplied with some which contains very little hypochlorite of soda. But any solution that is made in moderately close accordance with the U. S. P., either of 1870 or 1880, will answer well, no matter how old it is, if it has not been too long or too much exposed to the air, and a pound of such a solution costing not over 30 or 40 cents makes ten or eleven determinations.

An approximate table may be easily given which will be found fairly accurate to the second decimal place, and figures intermediate to those given, may easily be interpolated. The basis of the table is 1 c.c. of nitrogen equivalent to ·0027 gramme of urea, and the first and second columns apply to the measurement whether of the gas, or of the water displaced by the gas. The standard quantity of urine which yields the results given is 4 c.c., or 64 minims.

As this table may be found useful to those who apply the apparatus, it and the note which explains the mode of using it will be printed separately and put into each box containing the apparatus; and beside this, the box will have a small cut of the apparatus, with the directions for using it pasted on the lid.

UREA TABLE.

One cubic centimetre of nitrogen equal to ·0027 gramme of urea, or one minim volume of nitrogen equal to ·0027 grain of urea.

Four c.c. or 64 minims of urine give the columns of Results of Process.

Results of Process.		Percentage of urea indicated.	Urea in the 24 hours for each 473 c.c., or one pint of urine excreted.	
In c.c.	In minims.		In grammes.	In grains.
15	243	1.01	4.78	73.8
16	260	1.08	5.11	78.9
17	276	1.15	5.44	84.0
18	292	1.22	5.77	89.0
19	308	1.28	6.05	93.4
20	325	1.35	6.39	98.6
21	341	1.42	6.72	103.7
22	357	1.49	7.05	108.8
23	373	1.55	7.33	113.1
24	390	1.62	7.66	118.2
25	406	1.69	7.99	123.3
26	422	1.76	8.32	128.4
27	438	1.82	8.61	132.9
28	454	1.89	8.94	138.0
29	471	1.96	9.27	143.1
30	487	2.03	9.60	148.1
31	503	2.09	9.89	152.6
32	519	2.16	10.22	157.7
33	536	2.23	10.55	162.8
34	552	2.30	10.88	167.9
35	568	2.36	11 16	172.2
36	584	2.43	11.49	177.3
37	600	2.50	11.83	182.6
38	617	2.57	12.16	187.7
39	633	2.63	12.44	191.8
40	649	2.70	12.77	197.1
41	665	2.77	13.10	202.2
42	682	2.84	13.43	207.3
43	698	2.90	13.72	211.7
44	714	2.97	14.05	216.8
45	730	3.04	14.38	221.9
46	747	3.11	14.71	227.0
47	763	3.17	14.99	231.3
48	779	3.24	15.33	236.6
49	795	3.31	15.66	241.7
50	811	3.38	15.99	246.8
51	828	3.44	16.27	251.1
52	844	3.51	16.60	256.2
53	860	3.58	16.93	261.3
54	876	3.65	17.26	266.4
55	893	3.71	17.55	270.9
56	909	3.78	17.88	275.9
57	925	3.85	18.21	281.0
58	941	3.92	18.54	286.1
59	958	3.98	18.83	290.6
60	974	4.05	19.16	295.7

The use of this table is simple enough. The observer finds at the end of the twenty-four hours that, starting with the bladder empty, he has 1200 c. c. or 40 fluidounces of urine. Of this he or the nurse assays 4 c.c. or 64 minims for urea, and obtains a result of either 36 c.c. of gas or displaced water, or of the equivalent of this in the other way of measuring, namely, 584 minims of displaced water. Having either the 36 c.c. or the 584 minims he refers to the table under the double column of "Results of Process," and he follows down the column whose denomination he has until he reaches the number 36 or 584. He then follows this line horizontally across the page, and finds, first, that the urine contains 2.43 p.c. of urea; and next that this is equivalent to 11.49 grammes in 473 c.c. of the urine;—and next that it is equal to 177.3 grains of urea in one pint of 16 fluidounces of the urine.

Now if 473 c.c. of the urine contain 11.49 grammes of urea, the whole 1,200 c.c. will contain (As 473 : 11.49 : : 1,200 :) 29.15 grammes as about the amount excreted in the twenty-four hours.

Then if 1 pint of the urine contains 177.3 grains of urea, the whole 40 fluidounces, which being exactly $2\frac{1}{2}$ pints, will contain just $2\frac{1}{2}$ times that much, namely: (177.3×2.5=) 443.3.

This table does not aim at critical accuracy, chiefly because the subject does not admit it without confusing fractions and very abstruse calculations, for a cubic centimetre of urine is not a gramme, and the difference will vary with the specific gravity of the urine; and neither is a minim equal to a grain from similar considerations. But the errors of the table are believed to be not beyond the sphere of many other errors inseparable from the process in ordinary hands, as applied to urine in all kinds of pathological conditions, and all that is claimed for it is that it may be found practically useful in getting at proximate results speedily, and without the necessity of any other calculation than that required by the varying daily amount of urine. And it may farther be fairly claimed that the apparatus, process and table taken together will save much time and labor, and will improve and increase the opportunities of cultivating a field of labor and research which has been too much neglected for want of ready, easy means of investigation, even though these be wanting in technical accuracy. Perhaps very few persons will use this or any other apparatus and process well the first two or three trials, since it is through clumsiness and awkwardness and failure, that work with the hands is learned. But there are also few who will not become expert in a short time.

CONVALLARIA MAJALIS.

LILY OF THE VALLEY.

Dr. Edward Drummond, of Rome, writes to *The British Medical Journal* (see No. 1,194, November 17, 1883, p. 970), that he has lately met with an account of the use of this drug, in cardiac disease, as far back as the commencement of the seventeenth century, in an old Italian book of *Commentaries on the Materia Medica of Discorides*, by Dr. Pietro Andrea Matthioli, published in Venice in 1621, and Dr. Drummond gives the following interesting translation:

"The Germans use lily of the valley to strengthen the heart, the brain, and the spiritual parts, and also give it in palpitation, vertigo, epilepsy and apoplexy; also as a remedy for the bites and stings of poisonous animals; to quicken parturition; and for inflammations of the eyes. For this purpose they are wont to prepare the wine from the flowers at the time of the vintage; and then infuse them in old wine for forty days in the sun, and subsequently distill and re-distill (but not many times), along with lavender-flowers, rosemary and other aromatics. They then preserve it as one of the most precious things to be found amongst medicines, and they call it "aqua aurea," and preserve it, in vessels of gold and silver, against sudden attacks. They even believe that, given to persons actually *in articulo mortis* it is able to prolong life for several hours. In this, however, they are not unfrequently deceived, as I have myself witnessed."

In the above translation it must not be taken for granted that the words "distill and redistill" had their present meaning, for it is highly probable that they had not. Referring to Richardson and other authorities, it will be found that "to separate drop by drop," was formerly taken in a different sense, and had no necessary relation to rising in vapor and being condensed, or even to heat in any form. By the quotations given in Richardson, its present signification from some former more literal one can easily be traced, and in this translation it should probably be read as "percolate and repercolate" after the forty days' maceration.

Hence, it is probable that convallaria has been continuously used in medicine for several hundred years, and that its action on the heart has been long known. Its more modern and rational use in medicine, however, does not date back, so far as the writer

knows, farther than a paper on the subject by Prof. Germain Sée in the *Bull. Thérap.* for July, 1882. In connection with M. Hardy its physiological and therapeutic action were both investigated at length, and very important and definite results were reported. Its effects on the heart and arteries, although similar to those of digitalis, were not identical, and were not produced in the same way, while it was free from some of the inconveniences and disadvantages of digitalis. It was not cumulative and explosive as digitalis was reported to be. It did not interfere with digestion, but was perfectly well borne, the appetite rather increasing under its use, while the intestinal action was also improved. The diminution of the heart's frequency, under normal conditions, amounts to 10 or 15 beats per minute. Irregularity, especially of nervous origin, is lessened. Sensations of pulsations in distal vessels—e. g., in the head—are removed by it. At the same time the force of the cardiac action is increased. It has a powerful diuretic action, increasing the amount of urine to about three times its previous volume. (From *The Lancet*, August 26, 1882, p. 327.)

This paper attracted considerable attention, and was soon followed by others in France, Great Britain and this country. All agreed upon its potency as a cardiac agent. Some regarded it as an equal, and others as an inferior duplicate of digitalis. Some found it diuretic, others not at all so, while in a very considerable number of the trials the results were negative until toxic doses were used. Long ago it had yielded to chemistry two glucoside principles of very different and somewhat antagonistic action, and these, convallarin and convallamarin, were used separately, and the latter was alleged to be the cardiac agent, but with these also, discrepant results were obtained. In a year from the time of Prof. Sée's paper it seemed doubtful if convallaria was not a mere duplicate of digitalis, with the great disadvantage of being by no means so well studied or so well tried, yet stimulated into use by fashion and novelty, and by advertising.

If only a simple duplicate of digitalis, the already overloaded materia medica was much better without it. But if it differed materially in either quality or quantity of action, and was more free from collateral disturbance, the materia medica could not afford to lose the chances offered by it.

At about this period of its career the writer received a note from a very careful and close observer, saying that he considered it a valuable agent, which could not take the place of digitalis in his

hands, but which had a place of its own to which digitalis had been applied, but to which it was less applicable, and asking the writer to make a preparation of convallaria for critical trial. This was in the early spring of 1883, and there was no part of the plant to be had in this market. From the character of the plant, and from various considerations developed by the uses of the extract from its various parts by M. Hardy and others, the writer concluded that the root, if taken at the proper time, would be by far the best portion of the plant for medicinal use, and that a well-made fluid extract of the root would be far the best representative of the drug,—far better than the so-called active principles which, when divorced from each other,—if not made by—chemistry, were found to yield such discordant results.

A florist was found who had some fine beds under cultivation, and when the roots had fairly sprouted they were taken from the ground, cleaned and dried by a gentle radiant heat. In drying they lost just about 75 p.c. of their weight, this loss not varying more than 1 to 2 p.c. in four separate parcels. The dried root and sprouts were then ground so as to pass through a sieve of 20 meshes, and were made into a fluid extract which represented the dried root minim for grain.

As a rule, cultivated plants are not as active, medicinally, as wild ones, but this was the best that could be done. The menstruum used for exhausting the root at first proved not to be a good one, and yet this fluid extract, in the hands of several good observers, proved moderately effective, and some discrepancies in the published statements were shown to be probably due to the use of preparations of different makers, or of different materials.

Specimens of this fluid extract were sent to several good observers, and in course of a few months results were obtained which, although not fully sustaining the character of the drug, were yet sufficient to warrant a more extended usage. By this time a parcel of foreign wild flowers and flower stalk had arrived. These were made into fluid extract with a different and better menstruum,—namely, the Diluted Alcohol of the U. S. P. of 1880. It was, however, pretty plain from the sensible properties that this was not so active nor so good a preparation as that from the root, and therefore that the root collected at sprouting should be preferred. A very few therapeutic trials seemed to confirm this opinion, and by this time some foreign root arrived, was made up and distributed, and the supply of this has now been kept up for several months to all

who applied for it, thus gradually extending the number of those who were using this preparation, and adding them to the much larger number of those who were using the preparations of other makers, and who had used these long before this writer took up the subject.

Up to this time several competent and careful observers, free from the prejudice of novelty, and from the still more dangerous prejudice of basing general conclusions upon too few cases,—have reported their experience in a guarded way. This experience is still discrepant, and therefore difficult to state, so that perhaps all that can be safely said, is that the general kind and direction of the results show that convallaria is worthy of a more extended use before it can be either fully accepted or discarded. It may be pretty definitely said that it is not a simple duplicate of digitalis, nor is it adapted to supersede that important agent, in any large number of cases. Yet its use may serve to differentiate or discriminate between cases which have hitherto been classed together and all treated by digitalis, because there was no other agent that was applicable to any of the class.

If the uncertain indications from the use of convallaria thus far be not mistaken, the best that can be hoped from it is that it may materially aid physicians in splitting up the digitalis class into groups, some of which may be better managed by convallaria. It is also among the possibilities, if not among the probabilities, that it may prove either or both a substitute and adjunct to digitalis. There are many conditions in which digitalis fulfills all the indications required of it, but in which it cannot be continued in sufficient doses to maintain the good effects without disturbing the stomach and thus interfering with nutrition. In such, or in some of such cases at least, it may serve as a substitute or alternate. In other conditions which seem to indicate the effects of digitalis, but in which that agent does no good, or cannot be tolerated, convallaria gives a chance of relief where there may have been less chance without it.

Two or three years of careful observation, in good hands, extended over large numbers of cases, without prejudice, and with earnest investigation, will be absolutely necessary to establish the true and lasting character of convallaria, and it is this consideration which induces the writer to add his supply of a well-made fluid extract from good material to those of other makers who long preceded him in supplying it.

The dose of convallaria is, of course, the quantity which will

give the special or physiological effect, and this will be different in different cases. But the dose to begin with, and that which will be effective in some cases, is about 24 grains in the twenty-four hours. And as the fluid extract represents the drug minim for grain, the dose of that will be as many minims,—say 6 minims every four hours, or 8 minims 3 times a day,—the size or the number of the doses to be increased until some effect is obtained.

The fluid extract is miscible with water, and though it does not make a clear solution, the precipitate which settles out is probably, but not certainly inert. A good way to administer it is to put a measured quantity in a wine glass and add as many teaspoonfuls of water as may make up the number of doses required when given from the same teaspoon. For example, a fluidrachm is measured into a wine glass, and seven teaspoonfuls of water, or wine, or Diluted Alcohol are added and the mixture well stirred. Then using the same teaspoon, and stirring well at each dose, if water be the diluent, it is given in teaspoonful doses, which will be nearly eight minims each, farther diluted if desired at the time of taking it.

If the drug is to have a fair chance, there can be very little doubt that a well-made fluid extract of the root collected at the proper season is the best form in which to use it. In all drugs, the active principles of which are neither alkaloids nor acids, but are of that indefinite class called glucosides for want of a better generic name, it is pretty certain that these glucosides do not fully represent the drugs,—nor even well represent them. And when two or more glucosides are obtained from the same drug, the doubt is much strengthened. No one knows,—be he ever so good a chemist,—where the molecules of complex organic substances will split until he tries them, and therefore what he gets is often empirical, and may be the result of his chemical process, so that a different process may give different results. For example, Walz, in 1858, obtained from convallaria two glucosides which he named "convallarin" and "convallamarin." Dilute acids again split both of these into other bodies by subtracting a molecule of sugar, and one of the resulting bodies, minus half a molecule more of sugar, leaves the formula of the other original glucoside. Hence the inference that neither convallarin nor convallamarin exist in the plant, but that they are the result of the splitting-up of more complex molecules by chemical means. No one has ever proved that either of them pre-existed

in the plant, while the physiological action of the plant is not represented by the action of the two glucosides as given.

THE PHARMACOPŒIA OF 1880.

(Review Continued.)

List of Reagents.

No one of the many improvements of the Pharmacopœia of 1880 is adapted to be of more importance to the general progress of medicine than the introduction of the full list of reagents commencing at page 387, and it is noticed here out of the order adopted for this review, because of its application to the text throughout the book, and because of a desire to draw early and strong attention to it as a new and important element in pharmacy and therapeutics. If the progress in the drug market is to be maintained at its best rate, it must be by disseminating the knowledge and the means of discrimination between the good and the bad. The descriptions and testings given under the separate articles might be even more full than they are and yet be of limited advantage in a general way, had the design not been completed by supplying the definite means for their easy application. The Pharmacopœia has thus fulfilled its complete duty in the matter, and has done all that it can possibly do, and it now remains to be seen whether the physicians and pharmacists, who are so vitally interested, will avail themselves of the means thus placed at their disposal.

Any one can, at odd times, by the directions given, soon make for himself a set of these reagents, and when they are once in readiness and at hand they will be very likely to be applied, and when applied they will condemn and discard a very large proportion of the articles that are too commonly used in medicine. To those who are too busy to buy, or who will not take the trouble to make them for themselves, they are offered by the writer and by other manufacturers at a cost which places them within the reach of all, and it is the object of the writer in making them, and in writing this note, to urge their use upon all who dispense or use medicinal supplies, for their own best interests in the quality of their agents. Any one, in earnest with his work, who will make a beginning by the use of two or three of the important tests, will in a little while become skillful in their ap-

plication, and even upon a little experience the appetite for their application will grow until he has complete control of his market for supplies. In no other way will he so easily realize the true relation between price and quality; and in no other way will he so quickly learn to take off the screw of price, and to prevent those who keep it on from deceiving him. In the wholesale market price is too commonly omnipotent. It rules everything in a general way. But with a good Pharmacopœia, a good set of reagents and a little skill in the use of them, there is an effective check to this rule. This check may grow slowly, but it will grow surely, and those who hold it in their power will, in the race of competition, find themselves proportionately in advance.

The Officinal List of Reagents is divided into three sections. The first,—"Articles Used in Testing,"—embraces some fifteen or sixteen articles, generally simple in their nature, but needing some enumeration and definition to individualize them.

The directions under Hydrosulphuric Acid for generating the gas more commonly known as sulphuretted hydrogen, but better known as hydric sulphide, will be very useful. It is generally made in a very rude way, without any definite proportions, and its mismanagement renders it such a nuisance as to be very obstructive to its use. The common fault in the use of this important reagent is that it is made in great excess, and the excess constitutes the nuisance. Two square half ounce vials held together by a rubber band and fitted with perforated corks,—the one vial as a generator, the other as a wash bottle,—the latter with a small exit tube that will reach to the bottom of a 4-inch test tube,—makes a good apparatus for occasional use. This, charged with about half a gramme or about 8 grains of ferrous sulphide, and 2 or 3 fluidrachms of Diluted Sulphuric Acid, is quite sufficient for an ordinary testing, and if managed with care the odor and the discoloration from excess of gas are very slight. The residue should always be thrown out of doors and not into the sink, and thus much odor and discoloration is avoided,—a discoloration which can only be removed by strong acid.

The indicators given in this list are Litmus and Turmeric, and they will answer fairly well for most of the applications, but they are not so good as some of the more modern indicators, especially when used with Volumetric Solutions. For such purposes, one of the more modern ones has come into common use,—namely, phenolphthalein. This in solution, 1 part to 250 parts of Diluted Alcohol, forms a very sensitive and sharp indicator, which has many advan-

tages over Litmus. Several others not so well known as yet, promise to be of importance in the future.

Test-Zinc is another very important article of this section of the list. It is not uncommon to buy metallic zinc at a high price, as being free from arsenic which is not free, and then the zinc and the time and trouble are lost. The metal of the New Jersey Zinc Company is naturally free from arsenic and is very pure, and if this be asked for and obtained it is very inexpensive and just what is wanted.

The directions for the application of Marsh's test for arsenic are very full and clear. As hard glass tubing is sometimes difficult to get it may be useful to know that soft glass may be made to answer by winding a wide spiral of iron wire around it. It is also useful to know that a ghost of a mirror may often be obtained, from organic matters and other accidental causes, when no arsenic is present; and that of late it has been shown that nearly all German hard glass, and especially that of Thuringia, contains arsenic, and that this may under some conditions interfere with the test.

The second part of the list consists of the Test-Solutions, about 42 in number. Of these about 7 must be made at or near the time of using them, and two are prepared as needed by admixture of other Test-Solutions. Most of them are simple solutions of chemical salts in definite proportions in Distilled Water, and the general directions are 1 part of the salt *in* 10 or 20 parts of Distilled Water. These are all qualitative tests, but as much quantitative information is often obtained by their use the same reason for making them of definite strengths makes it a little better to have them made 1 part in 10 or 20 of the solution. As directed, 1 part in 10 parts of Distilled Water makes 11 parts in all, and this is a much less simple and manageable proportion when they are roughly used quantitatively, than 1 part in 10 of the solution, which would be 1 part to 9 of Distilled Water, giving a 10 p.c. solution.

It is not an uncommon practice to make them by measure, but this is also better to be avoided for the same reasons.

The best general way to make them is to put the weighed quantity of salt into a tared flask, add hot water enough to dissolve it by agitation, and then dilute to the total final weight with cold water.

The highest attainable purity of the salts used for these solutions is not necessary,—or rather is wasted in being used for them. Good commercial salts once or twice recrystallized and the crystals washed with distilled water and carefully dried,—give materials quite

good enough for such purposes, for it should be remembered that they are not intended for very fine or very accurate chemical work.

All excepting those of Indigo, Iodine, Nitrate of Silver and Permanganate of Potassium may be filtered through paper if the paper be good.

Glass stoppered bottles are necessary to some of them, and are best for all, and while the stoppers and necks are clean and dry, before the bottles are used, the ground surfaces should receive a very light coating of a soft paraffin, such as Petrolatum or vaseline. It is very easy to get too much of this on. A portion half the size of a pin's head, or just as much less as will make a greasy line down one side of the stopper, is all that is permissible. Then when the stopper is put in place and turned round a few times, it will be found that it turns smoothly and easily, and that the ground surfaces are just lubricated and no more. This is not necessary to make a well ground stopper tight, but is necessary to avoid the stopper becoming fixed after once or twice using. When a stopper is put in for transportation, it is done with a wooden stopper wrench, and of course such a wrench is necessary to take it out the first time, but after that they will be perfectly tight when simply screwed in gently with thumb and finger. This stopper wrench is described at page 170 of this series of pamphlets, and should be in possession of every one who uses glass stoppered bottles. It is easily and quickly made by any one, and will save a great many valuable bottles and a great deal of time and trouble, to say nothing of wear and tear of temper and patience. The proper use of paraffin on these, and on any other stoppers likely to become fixed, will be found to be a very great convenience, and a soft paraffin like the Petrolatum of the Pharmacopœia is much better than the hard paraffin which has to be melted, or the stopper and neck well warmed; and the soft is not nearly so liable to be used in excess.

The Test-Solution of Albumen must be recently made, and does not keep long, even if the egg be fresh. In certain cases where it is desirable to use the same solution day after day, and where glycerin is not objectionable, the addition of 25 p.c. of glycerin to the solution will enable it to be kept almost indefinitely. For some uses the officinal solution is better if diluted with an equal quantity of Distilled Water.

Test-Solutions of Ammonio-Nitrate of Silver and Ammonio-Sulphate of Copper being very easily made by the simple mixing of Water of Ammonia with two other test-solutions, need not be

bought or kept, as they can be made in a few minutes in any desired quantity.

The Test-Solution of Bitartrate of Sodium deposits a very considerable proportion of crystals when it cools. Authorities differ very much in regard to the solubility of this salt. Gmelin gives it as being soluble in 9 parts of cold water; Vogel in 12 parts. The latter is probably most correct.

The Test-Solution of Hydrosulphuric Acid, or sulphuretted hydrogen, if not quite saturated, and if kept with care, keeps in an available condition much longer than is generally supposed. If the saturated solution has about 10 p.c. of Distilled Water added, and is then not much exposed to air and light, it may be used for all ordinary purposes for months, and thus will often save the time and trouble of making the gas.

The Test-Solution of Potassio-Cupric Tartrate as given is a slight modification of Fehling's Solution, and seems to be hardly so good a modification as that given in Sutton's Volumetric Analysis, 1882, p. 256. This latter has the advantage of keeping the two solutions separate, and adding them in equal volumes as wanted for use. The solution, as generally made, rarely keeps well, and the conditions under which it is liable to change are not known. Hence, unless this officinal solution is known to keep unchanged under all conditions, it is better to keep the solutions separate and mix them as wanted, as advised by Sutton.

The Test-Solution of Sulphide of Ammonium is not directed to be recently made, nor need it be, for with a fair degree of care it keeps in a very useful condition almost indefinitely. It is best made at the same operation with the Test-Solution of Hydrosulphuric Acid, by leading the gas which is not absorbed by the water into another bottle containing about half the volume of Water of Ammonia. The saturation of the water may then be more quickly accomplished, while the gas which would be wasted, and became a nuisance, is saved, and the two solutions made as easily as one.

Test-Solutions of Ferricyanide of Potassium, Ferrous Sulphate, Gelatin, Tannic Acid and Tartaric Acid, should be made in very small quantities at a time, as wanted, and they are commonly made in small test tubes.

The third division of the List consists of six very important Volumetric Solutions.

These are even more useful than any other part of the List, because their indications are quantitative. They determine at

once the amount present of the elements sought for, and do this quickly and easily, but the obstruction to them is that they are supposed to require a burette and stand, and a good deal of skill to use them. It is true that it is much better to have all these, and no one who provides himself with them is ever likely to regret it. Yet an ordinary 10 c.c. graduated pipette which is not very costly, and a very little experience gained in a few trials, are all that are essential to obtain very fair practical results. The pharmacopœial aim is not at the extreme accuracy of the accomplished chemist with his well-supplied laboratory, but, at the present stage of progress in pharmacy at least, it only aims at such fairly approximate results as can be easily and quickly obtained, and as will serve to discriminate between good and bad medicinal supplies, or to distinguish the pharmacopœial substances from those sold under the same names which are not of the proper quality or strength.

These Volumetric Solutions are not so easily made as the Test-Solutions, as they require materials of more accurate constitution, and also much more accurate weighing and measuring, and yet with fair apparatus almost any one can make them for himself, on the scale that he requires them, the directions being plain and very simple, and when made their accuracy is very easily tested by applying them to substances of known composition.

Of course they require to be carefully kept, and carefully guarded against evaporation, and against the crusts which form around the mouth of the bottle and the stopper falling back into the bottle. And as a rule any portion poured out for use should be so small as to be all used, so as to pour none back into the bottle.

It is very much to be hoped that the whole of this important List will come rapidly into general use.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. MARCH, 1884. No. 2.

THE DISCUSSION ON MEDICAL ETHICS.

A paragraph in regard to the N. Y. County Medical Society, published in the last number of the Ephemeris, at page 438, requires correction. In the last two lines of the paragraph it is stated that "Just about 16 persons were present, and of these 4 were reporters, the two presidents making two others of the 16." This statement is erroneous. It was not carelessly made, but was given on the authority of a member of the Society, who was present and counted the persons. When the statement was denied, however, the author of it admitted that he did not remain in the room throughout the whole of the meeting, and as he knew very well that at these meetings members come in and go out throughout the whole of the sessions, such a statement should not have been made without counting throughout the whole meeting.

This writer desires to avoid publishing loose and inaccurate statements, and desires as prominently as possible to recall this one, and in order that this may be done to the entire satisfaction of the retiring President of the Society, his letter of complaint is given in full:

266 Madison Avenue, New York, January 21, 1884.

My Dear Dr. Squibb—On page 438 of your Ephemeris, Vol. II., No. 1, you say of the meeting of N. Y. Co. Med. Soc. next succeeding the Annual one, that "just about 16 persons were present, and of these 4 were reporters, the two presidents making two others of the 16." Your statement is false, and I can only account for it on the supposition that you have been misinformed. If you will look at the *minutes of* that meeting, which I forward you by this mail, you will find the names of about 25 persons recorded as present at

that meeting, with the statement that "about 40 others" were present. If you value truth you will at once correct so outrageous a misstatement by communicating the real facts to all to whom you have sent the untruth.

I think you will understand my feeling strongly on this subject, as I was the retiring president.

Sincerely yours, DAVID WEBSTER.

The above quoted letter may serve to illustrate a practice which throughout this controversy has done much harm. The use of harsh and affronting language to effect a simple purpose which could be far better accomplished without being uncivil, is always hurtful. No man of ordinary sensibilities can receive a letter like that without being hurt by it; and the tone and language always demonstrate one of two conditions of mind in the author. He either means an affront, or else is insensible or careless as to what constitutes an affront. An important and powerful element in all the successful associations of men is good fellowship. Politeness,—or hypocrisy under the garb of politeness,—however skillfully applied, can never take the place of fellowship, while impoliteness destroys it, and separates men as the law of repulsion does the molecules of matter. Men, as a rule, do not desire to avoid the responsibility for either their language or their actions, and therefore they must be taken to mean what they say and what they do, and be held personally responsible to society. Disruptive conduct merely calls out the circumstance that the world is wide enough to form any number of new fellowships as fast as the old are broken up by the growth of disturbing elements, and hence men will always refuse to be bound together in inharmonious or bad fellowship.

Pursuant to a call for that purpose, a meeting of delegates and permanent members of the State Society was held at the Delavan House, on Monday evening, February 4th, in advance of the annual meeting of the 5th, to take counsel upon a proper course to be adopted to uphold the National Code of Ethics. About 80 persons were present, and as the result of a free discussion of the subject it was informally decided that the two-thirds vote necessary to reverse the action of 1882 was impossible. The writer with other individuals had earnestly hoped and believed that with the lapse of another year a milder and more liberal spirit might prevail with the majority.

It had been shown by a thorough canvass of the State that a very large majority of the profession who could be prevailed on to vote,—and even a small majority of the total profession,—voters and non-voters, was opposed to the new movement. This confirmation of the often repeated statement that at the time of the action taken, the profession was not fully represented by the 70 votes present, could hardly have failed to show those in the ascendancy that their claim to the position was open to fair doubt. Beside, it was well known that a majority of the counties had failed to adopt the new by-law after it had been the law of the State Society that they must do so for a period of two years. This and much more led to the reasonable expectation of magnanimity. Hence this writer for one went to Albany with the expectation that the leaders of the new movement would say—Confident in the right and the success of our movement, we will concede to so large a proportion of the profession of the State the possibility of some justice in the claim of dissatisfaction with our method of proceeding, and will consent to replace the matter where it originally stood, and will come here in 1885 and regain the position we now temporarily concede, but do not abandon.

Whether the meeting at the Delavan House shared in any such expectation or not, it decided to leave no effort untried by which to secure a full vote at the approaching meeting, and declined to form a new State Association, as was urged by some members present, until after another failure to obtain a chance of preserving the old one. In case of another failure it was, however, decided to form a new society, and the details of such an organization were provisionally presented and discussed.

It was generally understood that the decisive vote on the subject of restoring the National Code would be taken in the State Society on Tuesday evening, and therefore the meeting at the Delavan House adjourned to meet again on Wednesday morning at 9 o'clock.

The vote was taken on Tuesday evening, and resulted in a slightly increased majority for the New Code, thus ending all hope of doing anything in the State Society. The question, then, which would naturally present itself to the defeated half of the Society would be, after all that has passed, can there ever be any honest, active or harmonious work in the old Society by those who, upon a square issue of professional principles have been thus repeatedly defeated,

and the answer would as naturally be no. When a large body is divided nearly in halves on a direct issue of principles of action, where each party feels equally earnest, the only logical course,—perhaps the only possible course,—is separation.

Perhaps with some such feelings in the members, the adjourned meeting of Monday evening was held on Wednesday morning, and the organization of a new society was effected, called The New York State Medical Association. A general outline plan having been adopted provisionally, officers were elected, definite arrangements were made for future action, and the Association adjourned to meet in New York City on the third Tuesday in November.

The following is the roll of membership of the founders of this new Association, as in the published minutes of the Convention which formed it, arranged in alphabetical order of the counties represented.

COUNTY.	NAME.	POST OFFICE.
Albany	J. W. Moore	Cohoes.
	Theodore P. Bailey	Albany
	S. Peters	Cohoes.
	R. H. Sabin	West Troy.
	W. B. Sabin	West Troy.
Broome	J. G. Orton	Binghamton.
	J. H. Chittenden	Binghamton.
	F. W. Putnam	Binghamton.
	C. B. Richards	Binghamton.
Cayuga	C. F. McDonald	Auburn.
Chenango	Geo. W. Avery	Norwich.
Chautauqua	Edward Ames	Sherman.
	William Chace	Mayville.
	H. J. Dean	Brocton.
	Thomas D. Strong	Westfield.
Clinton	E. M. Lyon	Plattsburg.
	L. C. Dodge	Rouse's Point.
	W. N. Coit	Champlain.
Columbia	Thomas Wilson	Claverack.
Cortland	H. O. Jewett	Cortland.
	Caleb Green	Homer.
	Frederick Hyde	Cortland.
	H. C. Hendrick	McGrawville.

Dutchess	De Sault Guernsey	Amenia.
	J. G. Porteus	Poughkeepsie.
	C. N. Campbell	Poughkeepsie.
	Wm. Cramer	Poughkeepsie.
	L. D. Leroy	Poughkeepsie.
	H. R. Powell	Poughkeepsie.
	C. M. Kittridge	Fishkill
	G. H. Codding	Amenia.
	Henry Slack	Fishkill.
	M. T. Pultz	Sandfordville.
Erie	Thomas F. Rochester	Buffalo.
	J. C. Green	Buffalo.
	Wm. Ring	Buffalo.
	John Cronyn	Buffalo.
	C. C. F. Gay	Buffalo.
	W. S. Tremaine	Buffalo.
	J. B. Andrews	Buffalo.
	F. F. Hoyer	Tonawanda.
	C. C. Wyckoff	Buffalo.
Essex	Conant Sawyer	Au Sable Forks.
	E F. Edgerly	Moriah Centre.
	Lyman Barton	Willsborough.
Franklin	William Gillis	Fort Covington.
Fulton	Isaac De Zouche	Gloversville.
Genesee	M. W. Townsend	Bergen.
	A. P. Jackson	Oakfield.
	W. B. Sprague	Pavilion.
	John R. Cotes	Batavia.
Jefferson	T. Mortimer Crawe	Watertown.
	Ira H. Abell	Antwerp.
	C. M. Johnson	Watertown.
Kings	R. M. Wyckoff	Brooklyn.
	Avery Segur	Brooklyn.
	E. R. Squibb	Brooklyn.
	Joseph C. Hutchison	Brooklyn.
	E. H. Squibb	Brooklyn.
	George W. Baker	Brooklyn.
	J. D. Rushmore	Brooklyn.
Livingston	John W. Gray	Avon.
Monroe	E. M. Moore	Rochester.
	B. L. Hovey	Rochester.
	R. C. Reynolds	Pittsford.

Montgomery	Alex. Ayres	Fort Plain.
	W. H. Robb	Amsterdam.
New York	John G. Adams	New York.
	Nathan Bozeman	New York.
	Allen S. Church	New York.
	E. M. Cameron	New York.
	W. S. Conover	New York.
	Wm. Detmold	New York.
	F. S. Dennis	New York.
	Abram Dubois	New York.
	Austin Flint	New York.
	Austin Flint, Jr	New York.
	W. H. Flint	New York.
	J. W. S. Gouley	New York.
	J. H. Hinton	New York.
	Samuel T. Hubbard	New York.
	Frank H. Hamilton	New York.
	Abbott Hodgman	New York.
	E. G. Janeway	New York.
	E. A. Judson	New York.
	Charles A. Leale	New York.
	Jared Linsly	New York.
	Wm. T. Lusk	New York.
	S. W. B. McLeod	New York.
	Thos. H. Manley	New York.
	H. D. Nicoll	New York.
	S. S. Purple	New York.
	Lewis A. Sayre	New York.
	L. H. Sayre	New York.
	Isaac E. Taylor	New York.
	T. Gaillard Thomas	New York.
	Carlos P. Tucker	New York.
	Charles S. Ward	New York.
	Charles S. Wood	New York.
	Whitman V. White	New York.
	Wm. T. White	New York.
	Joseph Wiener	New York.
	W. H. Welch	New York.
	Wm. Young	New York.
Oneida	John P. Gray	Utica.
	H. N. Porter	New York Mills.

Onondaga	Israel Parsons	Marcellus.
	H. D. Didima	Syracuse.
	Alex. J. Dallas	Syracuse.
	A. D. Head	Syracuse.
	Ely Vande Warker	Syracuse.
	H. B. Allen	Baldwinsville.
	J. O. Slocum	Camillus.
	G. W. Earll	Skaneateles.
	Henry L. Elsner	Syracuse.
	Jonathan Kneeland	S. Onondaga.
	L. C. Skinner	Belle Isle.
Ontario	F. R. Bentley	Cheshire.
	H. W. Nichols	Canandaigua.
	Jos. T. Smith	Canandaigua.
	E. W. Simmons	Canandaigua.
Orange	J. H. Thompson	Goshen.
Orleans	H. C. Tompkins	Knowlesville.
	James Chapman	Medina.
Otsego	J. K. Leaning	Fly Creek.
Putnam	G. W. Murdock	Cold Spring.
Queens	John Davidson	Hempstead.
Rensselaer	C. E. Nichols	Troy.
	J. C. Hannon	Hoosick Falls.
	W. Wotkyns Seymour	Troy.
	W. S. Cooper	Troy.
	M. H. Burton	Troy.
	E. D. Ferguson	Troy.
	Charles S. Allen	Greenbush.
	W. N. Bonesteel	Troy.
	H. E. Mitchell	Troy.
	J. B. Harvie	Troy.
	C. H. Burbeck	Troy.
	Z. Rousseau	Troy.
	W. H. Nichols	W. Sand Lake.
	Wm. Finder	Troy.
Richmond	Alfred L. Carroll	New Brighton.
	F. N. Johnston	New Brighton.
Rockland	Wm. Govan	Stony Point.
Saratoga	Tabor B. Reynolds	Saratoga Springs.
	George F. Comstock	Saratoga Springs.
	C. S. Grant	Saratoga Springs.

Saratoga	Robert E. McEwen	Saratoga Springs.
	M N. Babcock	Saratoga Springs.
	J. H. Lancashire	Saratoga Springs.
	Wm. Hodgman	Saratoga Springs.
	C. E. Creal	Saratoga Springs.
Schenectady	S. G. De La Mater	Duanes.
Seneca	E. J. Schoonmaker	Magee's Corners.
	E. Lester	Seneca Falls.
Suffolk	W. D. Woodend	Huntington.
Tompkins	J. E. Beers	Danby.
	Wm. Fitch	Dryden.
Ulster	G. W. Cooke	Kingston.
	E. McKenzie	Port Ewen.
	Aug. Hühne	Kingston.
Warren	M. R. Peck	Glens Falls.
Wayne	Darwin Colvin	Clyde.
	C. G. Pomeroy	Newark.
	J. N. Arnold	Clyde.
Westchester	N. C. Husted	Tarrytown.
	I. G. Collins	Sing Sing.
	Wm. C. Pryer	New Rochelle.

This roll now represents 40 counties of the State and includes 168 members. Other names from these and other counties are still being sent in to the officers of the Association, as the published Minutes of the Convention show the objects and plan of organization to those who are interested.

The pamphlet giving all the details of the Convention and the Association can be had on application to any of the officers, but especially from the Corresponding Secretary, Dr. E. D. Ferguson, of Troy, N. Y. Dr. H. D. Didima, of Syracuse, is President; Dr. Caleb Green, of Cortland, is Recording Secretary; and Dr. John H. Hinton, 41 West Thirty-second street, New York, is Treasurer.

One of the chief reasons for organizing a new State Society at this time is to be found in the fact that a large number of the county societies are in contempt of the old State Society by not having made their by-laws to conform to those of the State Society in the matter of the new code, and some of these have notified the State Society that they would not adopt the new by-law. Under these circumstances the only logical and proper course for the

State Society is to apply to the Legislature for a law suspending the corporate rights of all such county societies. Such a law can be easily obtained, and probably will be, and this will sever the connection of such county societies from the State Society, and in fact leave them without legal status of any kind, unless it dragoons them into compliance with the new by-law. This would convert them into voluntary societies, and then the new voluntary State Association being formed gives them the opportunity of being at once in a central society as before. If such a State Association had not been formed these disfranchised county organizations would have had nowhere to go, and that part of the profession not in harmony with the old State Society would become disintegrated. It has long been thought by many that the State and county organizations would gain much by surrendering their incorporation and all their legal relations to the State and resolving themselves into voluntary societies, and the new State Association is now to try this better way and invite the co-operation of local associations in the trial. It is not a new or untried plan, however, for by far the largest number of state societies are voluntary organizations, and entirely unembarrassed by the legal relations and complications which have gradually brought the Society of this State into the arena of politics. It is reported that in a hearing given by a legislative committee on the subject of passing one of the medical bills now before the Legislature, the representative of a very successful set of proprietary medicines said, in an impassioned speech, "If these men be 'regulars' I thank God I am a quack."

The history of the matter in the State Society, this year, is about as follows: Many members went to the meeting with great hopes of more pacific action, and others for the purpose of having their votes recorded on the side of their election, so that on the first day and evening it was the largest meeting ever held. The President, in his inaugural address, presented the present position of the subject in a temperate, calm and impartial way, and the evening session of Tuesday was appointed for considering and deciding the propositions laid over from last year, and the resolution of Dr. Didima, restoring the condition to what it was before the action of 1882, was understood to come up first. Near the appointed hour the room was well filled, and in the general expectancy abundant time and opportunity was given to the party in the ascendant for any moderation or liberality that might have

prevailed in their councils. But they did not take the opportunity offered, but broke the silence by a motion to take up the regular business of the Society. Dr. Didima was not present, so Dr. Rochester called up the resolution of Dr. Didima by a temperate and conciliatory introduction of the subject. Dr. Didima then came into the room and read his introduction of his resolution. Dr. Roosa replied to these, and having alluded to the meeting held at the Delavan House, on the preceding evening, as a threat to the Society, made use of a dramatic figure to the effect that that meeting came there with an olive branch in one hand and a hatchet in the other, which was exactly true, though not in the threatening way in which he presented it. Dr. Moore then made the point which had not been made in any previous part of the discussion, namely, that this Society had been largely instrumental in originating the American Medical Association, and in the formation and adoption of its Code of Ethics, and that, therefore, it was untrue to itself and discourteous to the National Association to thus rudely cut itself adrift without notice, especially when such action was unnecessary as well as discourteous. It would have been more just as well as more dignified to have first expressed dissatisfaction with its former action and asked to have it modified.

By this time it was very plain that all this was mere waste of time and breath, and that the matter was closed and settled irrevocably. The vote was called for, and when taken by ayes and noes, it was found to be 105 for the resolution, and 124 against it. To have passed the resolution would have required 153 affirmative votes. The effort was, therefore, shown to have been hopeless, but it was not useless, for it has placed on record another earnest effort, throughout two years, for justice, sound morals and fair play. To have abandoned the contest earlier would have been unmanly. To continue it any longer would be as unwise as it would be useless, and as the issue is one of fundamental principle and law, the true meaning of the action can only be a separation of the interests involved, for the future. Discordant elements, if held together by force, have no moral weight within or without, all the force they have being required to hold them together. Harmony and good fellowship once destroyed in any society by a permanent difference which reaches the degree of antagonism, little good can be expected until the disagreeing parties separate, so that each can manage its interests freely in its own way. Separated, each may accumulate new strength by attracting new elements in harmony with its work.

As this is in all probability a permanent separation and settle-

ment of the constituency of the old State Society, and as each member doubtless desires a clear definite record as to exactly where he stands, it is certainly well worth while to have a final record of the ayes and noes, and a table of their distribution by counties throughout the State. The following list is from the official record of the Secretary of the Society.

The ayes are in favor of restoring the Old Code of Ethics, and the noes are in favor of retaining the New Code :

AYES.

George Abbott.Permanent Member.Hamburgh, Erie Co.
Ira H. Abell.....P. M....Antwerp, Jefferson Co.
John G. Adams.....Delegate....New York Academy of Med.
Charles S. Allen.....Del .....Greenbush, Rensselaer Co.
Edward Ames.....Del .....Sherman, Chautauqua Co.
J. N. Arnold .....Del .....Clyde, Wayne Co.
Alexander Ayres.....P. M....Fort Plain, Montgomery Co.
Charles G. Bacon .....P. M....Fulton, Oswego Co.
Wm. C. Bailey.....Del.....Albion, Orleans Co.
F. J. Baker.....Del.....Lockport, Niagara Co.
Guy C. Bayley.....Del.....New York City, Dutchess Co.
John E. Beers.....Del.....Danby, Tompkins Co.
R. B. Bontecou .....P. M....Troy, Rensselaer Co.
Wilbur H. Booth .....Del.....Utica, Oneida Co.
John C. Boyd .....Del.....Monroe, Orange Co.
M. H. Burton .....P. M....Troy, Rensselaer Co.
A. M. Campbell.....Del .....Mt. Vernon, Westchester Co.
J. E. Casey .....P. M....Mohawk, Herkimer Co.
William Chace .....P. M....Mayville, Chautauqua Co.
James Chapman.....P. M....Medina, Orleans Co.
Alonzo Churchill.....P. M....Utica, Oneida Co.
Isaac G. Collins.....Del .....Sing Sing, Westchester Co.
Darwin Colvin.....P. M....Clyde, Wayne Co.
George W. Cooke.....P. M....Kingston, Ulster Co.
W. S. Cooper.... .....P. M....Troy, Rensselaer Co.
John R. Cotes .....P. M....Batavia, Genesee Co.
J. M. Crawe.....P. M....Watertown, Jefferson Co.
A. G. Crittenden.....Del .....Clifton Springs, Ontario Co.
John Cronyn .....P. M....Buffalo, Erie Co.
A. J. Dallas.....P. M....Syracuse, Onondaga Co.
J. C. Dalton.....P. M....New York, N. Y.
John Davidson .....P. M....Hempstead, Queens Co.

H. J. Dean.....Del.....Brocton, Chautauqua Co.
H. D. Didima.....P. M....Syracuse, Onondaga Co.
L. C. Dodge.....Del.....Rouse's Point, Clinton Co.
H. G. Dubois.....P. M....Camden, Oneida Co.
G. W. Earll.....P. M....Skaneateles, Onondaga Co.
J. W. Eddy.....Del.....Oswego, Oswego Co.
E. F. Edgerly.....P. M....Moriah Centre, Essex Co.
J. C. Edson.....Del.....Windsor, Broome Co.
E. D. Ferguson.....P. M....Troy, Rensselaer Co.
Wm. Fitch.....P. M....Dryden, Tompkins Co.
Austin Flint.....P. M....New York, N. Y.
Austin Flint, Jr.....Del.....Bellevue Hos. Med. Col., N Y.
Wm. Gillis.....Del.....Ft. Covington, Franklin Co.
J. W. S. Gouley.....P. M....New York, N. Y.
C. S. Grant.....Del.....Saratoga Springs, Saratoga Co.
Caleb Green.....P. M....Homer, Cortland Co.
F. S. Greene.....P. M....Coxsackie, Greene Co.
J. C. Greene.....P. M....Buffalo, Erie Co.
J. W. Grosvenor.....Del.... Lockport, Niagara Co.
D. Guernsey.....P. M....Amenia, Dutchess Co.
A. D. Head.....Del.....Syracuse, Madison Co.
John H. Hinton.....P. M....New York, N. Y.
E. E. Houghton.....Del.....Schenevus, Otsego Co.
B. L. Hovey.....P. M....Rochester, Monroe Co.
S. T. Hubbard.....P. M....New York, N. Y.
James H. Hunt.....Del.....Brooklyn, Kings Co.
N. C. Husted.....P. M....Tarrytown, Westchester Co.
Alexander Hutchins.....P. M....Brooklyn Kings Co.
Frederick Hyde.....P. M....Cortland, Cortland Co.
A. P. Jackson.....Del.....Oakfield, Genesee Co.
Charles Jewett.....Del.....Brooklyn, Kings Co.
Homer O. Jewett.....Del.....Cortland, Cortland Co.
C. M. Johnson.....Del.....Watertown, Jefferson Co.
T. M. Johnson.....P. M....Buffalo, Erie Co.
Frank Kenyon.....Del.....Scipio, Cayuga Co.
Henry Lapp.....P. M....Clarence, Erie Co.
W. E. Lauderdale, Jr.....Del.....Genesee, Livingston Co.
J. K. Leaning.....P. M....Fly Creek, Otsego, Co.
D. M. Lee.....Del.....Oxford, Chenango Co.
E. M. Lyon.....P. M....Plattsburg, Clinton Co.
Edward McKenzie.....Del.....Port Ewen, Ulster Co.
E. M. Moore.....P. M....Rochester, Monroe Co.

J. W. Moore .....Del .....Cohoes, Albany Co.
Robert Newman .....P. M....New York, N. Y.
C. E. Nichols.....P. M....Troy, Rensselaer Co.
H. C. Palmer .....Del.....Rome, Oneida Co.
T. E. Parkman.....Del.....Rock City Falls, Saratoga Co.
Israel Parsons.....P. M....Marcellus, Onondaga Co.
C. G. Pomeroy.....P. M....Newark, Wayne Co.
T. B. Reynolds.....P. M....Saratoga Springs, Saratoga Co.
William Ring.....P. M....Buffalo, Erie Co.
Thomas F. Rochester .....P. M....Buffalo, Erie Co.
Zotique Rousseau.....Del . Troy, Rensselaer Co.
Conant Sawyer.....P. M....Ausable Forks, Essex Co.
B. A. Segur.....P. M....Brooklyn, Kings Co.
W. P. Seymour.....P. M....Troy, Rensselaer Co.
John P. Sharer.....P. M....Little Falls, Herkimer Co.
S. Sherwell .....Del .....Brooklyn, Kings Co.
Henry Slack.....Del .....Fishkill, Dutchess Co.
George C. Smith.....P. M....Rondout, Ulster Co.
E. R. Squibb.....P. M....Brooklyn, Kings Co.
T. H. Squire.....P. M....Elmira, Chemung Co.
B. G. Streeter .....Del .....Glens Falls, Warren Co.
Thomas D. Strong.....P. M....Westfield, Chautauque Co.
A. W. Suiter .....Del .....Herkimer, Herkimer Co.
R. Thomson.... .....Del .....Troy, Rensselaer Co.
J. B. Todd.....Del .....Parish, Oswego Co.
W. M. Townsend.....P. M....Bergen, Genesee Co.
Ely Van de Warker.....Del .....Syracuse, Onondaga Co.
R. H. Ward.....P. M....Troy, Rensselaer Co.
Thomas Wilson .....Del.....Claverack, Columbia Co.
C. S. Wood .....P. M....New York, N. Y.
R. M. Wyckoff .....P. M ....Brooklyn, Kings Co.

Total Ayes, 105. Permanent Members, 61; Delegates, 44.

NOES.

J. Q. Adams.....Del .....Carmel, Putnam Co.
C. R. Agnew.....P. M....New York, N. Y.
W. T. Alexander .....Del .....New York, N. Y.
E. Allison.....Del.....Wayne, Steuben Co.
Wm. H. Bailey .....P. M....Albany, Albany Co.
M. J. Baker .....Del .....Hornellsville, Steuben Co.
N. H. Ballou .....P. M....Lansingburgh, Rensselaer Co.
C. C. Bartholomew.....Del .....Ogdensburgh, St. Lawrence Co.
Eugene Beach.....P. M....Gloversville, Fulton Co.

Frank D. Beebe	P. M.	Hamilton, Madison Co.
A. C. Benedict	Del	Yonkers, Westchester Co.
W. R. Birdsall	Del	New York Acad. of Medicine.
E. H. Bridges	P. M.	Ogdensburgh, St. Lawrence Co.
A. J. Browne	P. M.	Newport, Herkimer Co.
Wesley M. Carpenter	Del	New York, N. Y.
Charles Cary	Del	Med. Dept. Univer. of Buffalo.
F. A. Castle	P. M	New York, N. Y.
Walter B. Chase	P. M.	Brooklyn, Kings Co.
John R. Cooper	P. M.	Poughkeepsie, Dutchess Co.
W. H. Craig	P. M.	Albany, Albany Co.
H. S. Crandall	P. M.	Leonardsville, Madison Co.
W. W. Crandall	P. M.	Andover, Allegany Co.
J. P. Creveling	P. M.	Auburn, Cayuga Co.
F. C. Curtis	P. M.	Albany, Albany Co.
C. L. Dana	Del	New York, N. Y.
D. F. Dayton	Del	Potsdam, St. Lawrence Co.
F. R. S. Drake	Del	Med. Dept., Univer. of N. Y.
W. S. Ely	P. M.	Rochester, Monroe Co.
T. A. Emmet	P. M.	New York, N. Y.
J. D. Featherstonhaugh	Del	Cohoes, Albany Co.
L. E. Felton	P. M.	Potsdam, St. Lawrence Co.
G. J. Fisher	P. M.	Sing Sing, Westchester Co.
Frank P. Foster	P. M.	New York, N. Y.
George R. Fowler	Del	Brooklyn, Kings Co.
George H. Fox	Del	New York, N. Y.
R. Frazier	P. M.	Camden, Oneida Co.
S. H. Freeman	P. M.	Albany, Albany Co.
R. M. Fuller	Del	New York, N. Y.
P. R. Furbeck	P. M.	Gloversville, Fulton Co.
Arpad G. Gerster	Del	New York, N. Y.
V. P. Gibney	Del	New York, N. Y.
J. N. Goff	P. M.	Cazenovia, Madison Co.
Emil Gruening	Del	New York, N. Y.
Alexander Hadden	Del	New York, N. Y.
Wm. Hailes	Del	Albany Med. College.
C. R. Heaton	P. M.	Owego, Tioga Co.
Thomas Helme	Del	McKownville, Albany Co.
Everett Herrick	Del	N. Y. Acad. of Medicine.
B. L. Holt	Del	Pen Yan, Yates Co.
H. R. Hopkins	Del	Buffalo, Erie Co.
Joseph W. Howe	Del	New York, N. Y.

Lucien Howe.....Del.....Buffalo, Erie Co.
Edwin Hutchinson.....P. M....Utica, Oneida Co.
James C. Hutchison.....P. M....Troy, Rensselaer Co.
A. Jacobi.....P. M....New York, N. Y.
A. M. Jacobus.....Del.....N. Y. Acad. of Medicine.
Harvey Jewett.....P. M....Canandaigua, Ontario Co.
Laurence Johnson.....P. M....New York, N. Y.
Wm. H. Johnson.....P. M....Port Leyden, Lewis Co.
S. E. Jones.....Del.....Evans' Mills, Jefferson Co.
Charles M. Lefler.....Del.....Gloversville, Fulton Co.
Joseph Lewi.....P. M....Albany, Albany Co.
Daniel Lewis.....Del.....New York, N. Y.
David Little.....P. M....Rochester, Monroe Co.
A. V. B. Lockrow.....Del.....New York, N. Y.
A. L Loomis.....Del.....New York, N. Y.
Thomas Lothrop.....Del.....Buffalo, Erie Co.
Frank S. Low.....P. M....Pulaski, Oswego Co.
LeRoy MeLean.....P. M....Troy, Rensselaer Co.
A. Mandeville.....Del.....Rochester, Monroe Co.
Henry March.....P. M....Albany, Albany Co.
Arthur Mathewson.....P. M....Brooklyn, Kings Co.
W. F. Mittendorf.....Del.....New York, N. Y.
Joseph Moffatt.....Del.....Washingtonville, Orange Co.
G. G. Monroe.....Del.....Crary's Mills, St. Lawrence Co.
B. A. Mynderse.....P. M....Schenectady, Schenectady Co.
C. A. Nicholson.....P. M....Beekman, Dutchess Co.
H. H. Nye.....Del.....Wellsville, Allegany Co.
E. H. Parker.....P. M....Poughkeepsie, Dutchess Co.
E. L. Partridge.....Del.....New York, N. Y.
R. W. Pease.....P. M....Syracuse, Onondaga Co.
Maurice Perkins.....P. M....Schenectady, Schenectady Co.
A. M. Phelps.....P. M....Chateaugay, Franklin Co.
H. G. Piffard.....P. M....New York, N. Y.
O. D. Pomeroy.....Del.....New York, N. Y.
T. R. Pooley.....P. M....New York, N. Y.
C. H. Porter.....P. M....Albany, Albany Co.
J. D. Potter.....Del.....Delphi, Onondaga Co.
W. W. Potter.....P. M....Buffalo, Erie Co.
J. S. Prout.....P. M....Brooklyn, Kings Co.
P. V. S Pruyn.....P. M....Kinderhook, Columbia Co.
John O. Roe.....P. M....Rochester, Monroe Co.

D. B. St. John Roosa	P. M.	New York, N. Y.
P. R. H. Sawyer	P. M.	Bedford, Westchester Co.
A. S. Seeber	Del.	Milford, Otsego Co.
B. C. Senten	Del.	Whitehall, Washington Co.
George Seymour	Del.	Utica, Oneida Co.
John C. Shaw	Del.	Brooklyn, Kings Co.
Wm. F. Sheehan	Del.	Rochester, Monroe Co.
B. F. Sherman	P. M.	Ogdensburgh, St. Lawrence Co.
George F. Shrady	P. M.	New York, N. Y.
Wm. Manlius Smith	P. M.	Syracuse, Onondaga Co.
Norman L. Snow	P. M.	Albany, Albany Co.
H. G. P. Spencer	P. M.	Watertown, Jefferson Co.
C. L. Stiles	P. M.	Owego, Tioga Co.
E. V. Stoddard	P. M.	Rochester, Monroe Co.
F. H. Stuart	Del.	Brooklyn, Kings Co.
F. R. Sturgis	P. M.	New York, N. Y.
Wm. Taylor	P. M.	Canastota, Madison Co.
R. K. Tuthill	P. M.	Poughkeepsie, Dutchess Co.
S. O. Vander Poel	P. M.	New York, N. Y.
A. Vanderveer	P. M.	Albany, Albany Co.
E. Van Slyke	Del.	Albany, Albany Co.
S. B. Ward	P. M.	Albany, Albany Co.
John S. Warren	Del.	New York, N. Y.
David Webster	P. M.	New York, N. Y.
Francis M. Weld	Del.	New York Academy of Med.
Wm. C. Wey	P. M.	Elmira, Chemung Co.
J. H. Wheeler	P. M.	Athens, Greene Co.
C. E. Willard	P. M.	Catskill, Greene Co.
H. R. Winter	Del.	Phoenicia, Ulster Co.
C. E. Whitbeck	P. M.	Cohoes, Albany Co.
Wm. Woodward	Del.	Big Flats, Chemung Co.
W. Gill Wylie	Del.	New York, N. Y.

Total noes, 124. Permanent Members, 70 ; Delegates, 54.

Total vote, 229. Permanent Members, 131 ; Delegates, 98.

In 1883 there are 44 persons voting Aye who are not on either list in 1884. In 1883 there are 22 persons voting No who are not on either list in 1884. Two changed their votes from Aye in 1883 to No in 1884, and one changed his vote from No in 1883 to Aye in 1884. Doubtless some who do not appear in the lists of 1884 are delegates whose time had expired, and who were replaced by other names.

TABULAR ANALYSIS OF THE VOTE BY AYES AND NOES.

COUNTIES.	DELEGATES.				PERMANENT MEMBERS.				MAJORITY VOTE.						Vote by Counties.		
	Total number authorized.	Total number present.	Vote.		Total number on roll.	Total number present.	Vote.		By Delegates.		By Permanent Members.		Total majority.				
			Aye.	No.			Aye.	No.	Aye.	No.	Aye.	No.	Aye	No.	Aye.	No.	Tie.
Albany	4	4	1	3	15	11	...	11	...	2	...	11	...	13	...	1	...
Allegany	1	1	..	1	1	1	...	1	...	1	...	1	...	2	...	1	...
Broome	1	1	1	...	5	...	...	...	1	...	...	..	1	...	1	..	...
*Cattaraugus	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...
Cayuga	2	1	1	.	3	1	...	1	1	...	1	...	...	...	...	..	1
Chatauqua	2	2	2	...	2	2	2	...	2	...	2	...	4	...	1	..	...
Chemung	1	1	...	1	2	2	1	1	...	1	..	...	...	1	...	1	...
Chenango	1	1	1	...	7	..	..	...	1	...	...	..	1	...	1	...	...
Clinton	1	1	1	...	1	1	1	..	1	...	1	.	2	..	1	...	..
Columbia	1	1	1	...	1	1	...	1	1	...	...	1	.	..	...	...	1
Cortland	1	1	1	...	5	2	2	..	1	...	2	...	3	...	1	...	...
*Delaware	1	...	...	...	1	..	...	...	...	...	...	...	...	...	...	...	...
Dutchess	2	2	2	...	6	5	1	4	2	...	...	3	...	1	...	1	..
Erie	5	3	..	3	13	8	7	1	...	3	6	...	3	...	1	...	...
†Essex	1	...	...	...	2	2	2	...	...	...	2	...	2	...	1	..	...
Franklin	1	1	1	...	1	1	...	1	1	...	...	1	...	...	...	...	1
Fulton	1	1	...	1	2	2	...	2	...	1	...	2	...	3	...	1	...
Genesee	1	1	1	...	3	2	2	...	1	...	2	...	3	...	1	...	...
†Greene	1	..	...	...	3	3	1	2	...	...	...	1	...	1	...	1	...
‡Hamilton	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Herkimer	1	1	1	...	4	3	2	1	1	...	1	.	2	...	1	...	...
Jefferson	2	2	1	1	3	3	2	1	...	...	1	...	1	...	1	...	...
Kings	12	6	3	3	13	7	4	3	.	...	1	...	1	..	1	...	...
†Lewis	1	...	...	...	1	1	...	1	...	...	...	1	...	1	...	1	...
Livingston	1	1	1	...	2	...	...	...	1	...	...	...	1	..	1	...	...
Madison	1	1	1	...	3	4	...	4	1	..	...	4	...	3	...	1	...
Monroe	3	1	...	1	10	6	2	4	...	1	...	2	..	3	...	1	...
†Montgomery	1	...	...	...	4	1	1	..	..	...	1	...	1	...	1	...	...
New York	24	18	...	18	44	20	7	13	...	18	...	6	..	24	...	1	...
Niagara	2	2	2	...	1	...	...	..	2	...	...	...	2	...	1	...	...
Oneida	3	3	2	1	9	4	2	2	1	...	...	...	1	...	1	...	...
Onondaga	3	2	1	1	11	6	4	2	...	...	2	..	2	...	1	...	...
Ontario	1	1	1	...	2	1	...	1	1	...	...	1	...	...	...	...	1
Orange	2	2	1	1	2	...	...	...	...	...	...	...	...	...	...	...	1
Orleans	1	1	1	...	1	1	1	..	1	...	1	.	2	...	1	...	...
Oswego	2	2	2	...	3	2	1	1	2	...	...	...	2	...	1	...	...
Otsego	2	2	1	1	3	1	1	...	...	...	1	...	1	...	1	...	.
Putnam	1	1	...	1	...	...	...	...	...	1	...	...	...	1	...	1	...
†Queens	2	...	...	...	4	1	1	...	...	...	1	...	1	...	1	...	...
Rensselaer	3	3	3	...	12	10	7	3	3	...	4	...	7	...	1	...	...
*Richmond	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	..	...
*Rockland	1	...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...
St Lawrence	3	3	...	3	4	3	...	3	..	3	...	3	...	6	..	1	.
Saratoga	2	2	2	...	1	1	1	...	2	...	1	...	3	...	1	..	...
†Schenectady	1	...	...	...	1	2	...	2	...	...	...	2	...	2	...	1	...
*Schoharie	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...
*Schuyler	1	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...
*Seneca	1	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...
Steuben	2	2	...	2	5	..	..	...	...	2	...	.	.	2	...	1	...
*Suffolk	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...
*Sullivan	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...
†Tioga	1	...	...	...	2	2	...	2	...	...	...	2	..	2	...	1	...
Tompkins	1	1	1	...	2	1	1	...	1	..	1	...	2	...	1	...	...
Ulster	3	2	1	1	6	2	2	...	...	...	2	...	2	...	1	...	...
Warren	1	1	1	..	...	...	...	...	1	...	...	...	1	...	1	..	...
Washington	2	1	...	1	2	...	...	...	...	1	...	...	...	1	...	1	...
Wayne	2	1	1	...	4	2	2	...	1	...	2	...	3	...	1	..	...
Westchester	3	3	2	1	7	3	1	2	1	...	...	1	...	...	...	...	1
*Wyoming	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Yates	1	1	...	1	3	.	...	...	...	1	...	.	...	1	...	1	...
	128	88	42	46	253	131	61	70	31	35	34	43	54	67	26	17	6
Albany Medical College	1	1	...	1	...	...	...	...	...	1	...	...	...	1	...	...	...
Syracuse Medical College	1	1	...	1	...	...	...	...	...	1	...	...	...	1	...	...	...
N.Y. University	1	1	...	1	...	...	...	...	...	1	...	...	...	1	...	...	...
" Academy of Medicine	5	5	1	4	...	...	...	...	...	3	.	...	...	3	...	...	...
Bellevue Medical College	1	1	1	..	...	...	...	...	1	...	...	...	1	...	...	...	...
Buffalo Medical College	1	1	...	1	...	...	...	...	..	1	..	...	...	1	...	...	...
	128	98	44	54					39	42			55	74	...	...	..

By the foregoing table it will be seen that there are 59 County Medical Societies in the 60 counties of the State, and that 49 of these were represented in this vote at this Annual Meeting of the State Society.

Ten Societies were not represented at all.

Six Societies were not represented by delegates but were represented by permanent members, and the remaining 43 were represented by delegates, and nearly all by permanent members also. The vote by 98 delegates gave a negative majority of 10. The vote by 131 permanent members gave a negative majority of 9, making the total majority 19.

The vote by counties gives 26 in favor of the Old Code, 6 ties, and 17 in favor of the New Code.

It thus appears that a majority of the counties voting are not in favor of the position of the State Society on this subject, but are overruled and carried against their principles by the large and solid numerical vote of New York and Albany Counties. This puts the State in the attitude of being ruled professionally by these two counties.

The revised and corrected Catalogue of the profession of the State, made with great labor and pains by the Central Organization to Uphold the National Code of Ethics, has now been published, and shows a record of the names and addresses of 5,002 physicians of the State, all supposed to be regular physicians in good standing. Of these, 3,860, or a little over 77 per cent., voted directly upon the Code issue, the remaining 23 per cent. declining to vote at all. Of the 3,860 who voted, 2,547, or nearly 66 per cent., sustained the old Code ; 1,040, or nearly 27 per cent., voted for the new Code, and 239, or a little more than 6 per cent., voted for no code, while 34 votes were too indefinite to be counted on either side.

Now as the vote of 3,860 is considerably more than three-fourths of the catalogued profession of the State, and as 2,547 is very nearly two-thirds of this 3,860, it appears that the combined opposition to the old Code is a minority of very little over 33 per cent. ; and yet this minority, after a two years' contest, rules the profession of the State ; showing that an active, vigilant, unsparing minority is stronger than a supine, inactive body of twice their number ; and that this large majority has allowed its central organization to be captured and held, on a grave moral issue, and

has either surrendered with its defences or fled to the woods of disorganization.

Time will show whether this be an instance of submission to minority rule and affiliation with minority policy, for the sake of minority advantages, or whether it be not rather a conservative dislike for controversy and conflict which is so strong as to make the majority withdraw from the field of contest to seek a more harmonious fellowship.

MEASUREMENT OF GASES BY THE WATER DISPLACED.

At page 447 of the last EPHEMERIS the device of measuring gases by measuring the water displaced by them, is mentioned as a convenient one where great accuracy is not needed, and the process is described and a simple form of apparatus shown. No originality is claimed for the device, because it was taken for granted that it had surely been adopted in one form or another hundreds of times by hundreds of persons working upon lines where its convenience would be naturally suggested as in the instance then under consideration. Since the publication of the article, however, the writer's attention has been called, by his friend Mr. P. Casamajor, to the fact that the well-known French chemist, Maumené, as long ago as 1876, gave a description and cut of an apparatus almost identical in design and effect, and called the apparatus a Gashydromètre. It is, therefore, but simple justice to refer to this circumstance and mention that in Maumené's Traité de Fabrication de Sucre, vol. I., p. 414, the description and cut may be found, embracing exactly the same principle as applied to the measurement of gases from furnaces, from bone black, and in testing limestone, etc. Doubtless others, as well as the writer, had used the device before this publication, but still here it is published in full detail, and might have served for a model for the writer's description and cut without credit for it.

FLUID EXTRACT OF SENEGA.

Pharmacists and physicians frequently complain of and send back this fluid extract as being "worthless" or "spoiled," because occasionally it gelatinizes. All good Senega root contains a large

amount of pectin, and the better the root the more pectin it appears to contain; or at least when the fluid extract is made from root of only fair quality, it is never the subject of complaint. But when the root is of very good quality and very strong in its sensible properties, the preparation gives the maker a great deal of trouble and letter-writing about it A curious circumstance is, that in the writer's experience of twenty-five years and many thousand pounds of this preparation, he does not remember to have seen a single bottle gelatinize until after it had been sent out. This, and the circumstance that complaints are most common in winter, seems to show that the cold of transportation or of places where it is kept is the cause, and the object of this note is simply to say that the gelatinized preparation only has to be well warmed up to become as fluid as ever, and of course as good as ever. But there is much more to be said on the subject if it ever be reached in the review of the Pharmacopœia in these pages.

TESTING URINE FOR ALBUMEN.

Worcester and Dunglison give the spelling "albumen." The chemical dictionaries give it "albumin." The first is the older or original word. The second is the chemical substance, and belongs to a class with names ending in "in." This is probably now the better word, though as yet it seems a little pedantic to use it.

The pronunciation also seems to be undergoing change. The authorized "albu'men" is rarely heard now, the accent on the second syllable having grown less marked in usage and often hardly heard,—all the syllables being accented nearly alike. In other cases a slight preponderance of accent is heard on the first syllable—almost "al'bumen," and chemists occasionally call it "al'bumin," accenting the first two syllables lightly and the third a little more strongly. "Albu'minous," "Albu'minoid," etc., are usually heard, and for plain reasons.

Some time and pains have been recently given to the various tests for albumen in urine with a view to get some simple, easy way of estimating quantity rather more closely than is generally done, but the efforts have been without any important results. The common method of estimating by the appearance of the settled coagula in the test-tube was found, as was expected, very fal-

lacious. Albumen, in pretty rapidly diminishing quantity in the same urine, will often give nearly the same volume at the bottom of the tube after the same length of time to settle, and this was found to be due to the looser flocculi of the smaller proportions. The better common plan, which is doubtless followed by most well-trained physicians, was not improved upon, but may be worth formulating for the benefit of such as may not have a good method of assay.

A common test-tube of about 50 c.c. capacity is marked by a file at 30 c.c. = 1 fluidounce. It is filled to the mark with the urine, acidulated with a few drops of acetic acid, and boiled with the precaution of heating on the side to avoid explosive boiling and loss, as described in testing for sugar. Two small filters are made to counterbalance on a scale, by clipping the heavy one. They are then put together, folded, placed in the funnel, and the contents of the test-tube poured upon them. If the quantity of albumen be small, a second portion is boiled while the first is being filtered, and is poured upon the same filter. After the liquid has drained through, the test-tube is rinsed with water enough to fill the filter to the edge, and this is poured on. Under ordinary circumstances of approximate rapid estimation this will be sufficient washing. When drained the filter and contents are put in a warm place to dry for about twenty-four hours. The outside filter is then taken off and put onto the weight-scale pan, and the inner one with its contents onto the other pan, and weights added to equilibrium.

Taking two filters of equal weight is better than a single tared filter, because each filter will retain the same amount of solids from the washing, and each will be dried to the same degree of dryness, so that at the end they will counterbalance as they did at the beginning, though both may have changed weight.

If the weighing be done by metric weights, each 3 centigrammes of dried albumen is about one-tenth of 1 p.c. in the urine if 30 c.c. has been taken, or a half of that proportion if 60 c.c. was taken. If grain weights be used, then each grain of albumen would be equal to about twenty-two hundredths (·2174) of 1 p.c. because 30 c.c. is one fluidounce of say 460 grains of urine. Suppose the weight of the albumen be 10 centigrammes, or one and a half grains. Then the urine will contain approximately 0·33 p.c of albumen.

Next, suppose the patient is passing 1,200 c.c. or 40 fluidounces

of this urine in the 24 hours, then if 30 c.c. give 10 centigrammes, 1,200 c.c. will contain 4 grammes as the daily rate of excretion.

Then 40 fluidounces is 19,200 minims and 0·33 p.c. of this is about 63 to 64 grains as the daily rate of excretion.

The great objection to this process,—and that which makes some other very desirable,—is that it requires a more sensitive and costly scale and weights than physicians usually possess.

The natural substance richest in albumen is the white of egg, and this contains about 12 p.c. Healthy blood contains about 7 p.c., and according to Frerichs the urine in disease will contain from 1.5 p.c. to 0·25 p.c. Niemeyer states that patients will occasionally lose from 12 to 20 grammes of albumen a day by the urine. This, if the daily excretion be about 1,200 c.c. would give 1 to 1.67 p.c. But if the quantity of urine be less than normal the percentage would be greater. It is probable, however, that the proportion rarely exceeds 3 or 4 p.c. It is the smaller proportions of albumen, however, which are extremely important to be recognized and estimated, because they belong to the more curable stages of disease; and to have a weekly or semi-monthly estimate of quantity is often a very important matter in the management of such cases, and the efforts to do this without a good balance and weights were fruitless in the writer's hands. Such an apparatus should be a part of the outfit of every physician who aims to be an accurate and close observer, not only for this use but for many others. If the balance be a good one it cannot be kept so very long without a glass case, and the office mantel-shelf is an excellent place for weighing.

Within the past ten years the number of good tests for albumen have been largely multiplied, and many of these exceed the older tests by nitric acid and by heat, both in delicacy and convenience. And as an effect of the extreme delicacy of some of these tests proportions of albumen are now discoverable which neither heat nor nitric acid, nor the two combined, will detect.

Perhaps the most practically useful of all these newer and more delicate tests, although not the best, is picric acid, an artificial solid acid, obtainable from many sources, but commonly made from the phenol of coal tar or carbolic acid. It now appears that picric acid has been used as a test for albumen in urine for at least twelve years, (see *The Lancet* of November 11, 1882, p. 823,) but the first published account of such use appears to have been by A. M. Galippe, in French current literature of, or prior to 1873. It did not, however, attract much public notice until 1882, when Dr. George

Johnson, of London, led by some investigations made by his son, reapplied it to the testing of urine, and published his results supposing them to be new. His paper on the subject is in *The Lancet* of November 4, 1882, p. 737, and a letter of explanation in the same journal of November 11, 1882, p. 823. In his original paper he says, in substance, that the solution or the solid acid, in crystals or in powder, are so efficient and convenient in use that they may, with advantage, take the place of the more common tests. His very vigorous and emphatic advocacy of the test brought out several well-founded objections to it, and some more that were equally applicable to other, if not to all the tests, with the general result that it has been pretty well scrutinized, and found to be generally useful, though untrustworthy in exceptional cases. In common with all the other known tests it cannot be trusted alone in doubtful or critical cases, and its evidence is doubtful in a larger number of instances than some other tests; and especially is more uncertain than heat or nitric acid. Yet in a very large majority of cases it is equally applicable with these standard tests, while it is much more convenient and easy of application, and therefore adapted to much more extensive use. Beside, it has the very important advantage that in the onset of albuminous urine it will serve to detect the albumen long before heat or nitric acid. Indeed, so delicate is this and one or two other of the newer tests, that if there be no fallacy in their results, they have shown that small proportions of albumen, like small proportions of sugar, are by no means uncommon in the urine of healthy persons. One author, Chateaubourg, of Paris, has recently shown that in examining the urine of 329 healthy soldiers, albumen was found in 245 of the specimens, or over 74 p.c. And in the urine of 142 healthy children, from 6 to 15 years of age, albumen was found in 111, or more than 77 p.c.* Such results seem to show that small proportions of albumen in urine, as shown by the more delicate tests, have, when taken alone, little or no pathological significance.

Based upon the foregoing published data and deductions, the writer offers the following, which are perhaps re-determinations upon the use of picric acid, with the hope of confirming Dr. Johnson's statements as to the practical value in every day use, and especially at the bedside :

* Quoted from a paper on "The Comparative Value of the Newer Tests for Albumin in Urine," by Charles W. Purdy, M. D., published in the Journal of the American Medical Association of Jan. 19, 1884, p. 57.

The observations were all made upon pathological specimens of albuminous urine with small proportions of albumen, and when these were diluted to contain known smaller amounts, the diluent was always normal urine, which gave no trace of albumen. The urine used which was richest in albumen contained only 0·15 p.c. by the process given above, and this urine when diluted with an equal measure of normal urine, and thus containing 0·075 p.c., or seventy-five ten thousandths, gave the smallest amount of albumen that could be estimated on a balance sensitive to one-twelfth of a grain. But urine containing about one-tenth this proportion of albumen, under only fairly good management, gave the indication by heat. This, however, seemed to be about the limit in two different specimens, though different specimens do differ in limit even when acidulated and boiled in the same way.

These same two specimens diluted beyond this, and even very considerably beyond any indication by either heat or nitric acid, gave distinct evidence of albumen with picric acid. Two other specimens of pathological urine where the symptoms of the patients indicated that albumen might be expected, failed to give any indications by heat or nitric acid, but did give distinct indications with picric acid.

These observations, so far as they go, confirm the much more extensive and complete observations of Dr. Purdy, whose paper was alluded to above, but these were made under somewhat different conditions, and with the single view to the use of picric acid.

There are two good ways of applying picric acid to this use: the first in the state of powder, and the second is in the saturated solution now officinal in the Pharmacopœia under the title of Test-Solution of Picric Acid.

The convenience of the powder for bedside use seems to be sufficient to overbalance the uncertainty of the reagent in rare cases, because its common use in the sick room is simply to determine whether or not a farther or better examination is to be afterward made. It never fails to indicate albumen when it is present, but sometimes gives the indication when it is not present, as when patients are taking alkaloids or their salts in considerable quantities. Thus it is a safe dependence at the bedside, if not a certain one. For such use the crystals are rubbed into fine powder and are carried in the smallest size of homœopathic vials, such a vial holding enough for more than a hundred testings. The urine in the sick room, when scarcely cold, is generally quite transparent, but if not so it must be

warmed, and this is easily done by holding the filled test-tube in warm water. Then in a good light, with sharp sight, a few particles of the powder—and there should be only a very few—are put upon the surface of the urine. As these descend slowly through the column of urine a thin opalescent cloud will be seen around the particle and in its track, if the urine be albuminous, and the cloud will be light or dense in proportion to the amount of the albumen. In normal urine the particle goes to the bottom surrounded and followed by a track of yellow solution that is easily seen in the urine, even though high colored; but this solution which gyrates and curls around through the liquid just as the cloud does in albuminous urine, is perfectly transparent if the urine be so, and the only difficulty, and this is not a slight one, is in deciding whether these currents be *perfectly* transparent or not, or if they be not perfectly transparent whether the cloudiness be normal or abnormal albumen. If the proportion of albumen exceed a mere trace, there is never any doubt about the cloudiness of the currents, and if it reach the proportion of one hundredth of one per cent. the cloudiness is very distinct.

An ounce of picric acid can be bought for about 40 c., and 5 grains of it rubbed into fine powder will serve a physician in active practice for such use for many months. The remainder, or a part of it, dissolved in warm water, in the proportion of about 1 in 50, will give a solution from which a portion will crystallize out, leaving a saturated solution. Or, the Test-Solution of Picric Acid of the U. S. Pharmacopœia can be ordered from the druggist or pharmacist.

This solution of picric acid is a more satisfactory test than the powder, but is not so easily or conveniently carried as the very small portion of powder. It is best adapted to office use, and then as an addition to the heat and nitric acid tests, it leaves little to be desired, while it reaches far beyond the scope of these standard tests, and will generally replace them, even within their scope, by the convenience and rapidity with which it is applied. Like nitric acid it stains the fingers yellow, but unlike it in that the stains are removable by washing with soap.

It is applied by simply pouring the solution onto the urine in a test-tube held in a much inclined position, and without agitation, or by pouring the urine onto the solution. The liquids will mix spontaneously, and the cloudiness will promptly appear even when it is very faint. When faint the tube should be held against a dark background.

In specimens of urine where the proportion of albumen is so small as to leave a doubt whether any be present by the above described methods of using the picric acid, the doubt can often be cleared up entirely by a little change in the management, as follows: Put about half an inch of the picric acid solution into the clean test-tube, and then with a very small pipette deliver about the same quantity of the clear urine at the bottom of the test-tube underneath the solution. The urine should be delivered slowly so as to push up the solution without admixture, and when this is skillfully done with a little experience in doing it, an opalescent belt or stratum will appear in the middle where the two liquids come together, very much as when testing by putting nitric acid in first, and then, with the tube very much inclined, pouring the urine on top of it. But with picric acid the stratum is much thicker and more diffused, occupying usually the middle third of the liquids. By very careful and skillful management in pouring the urine on top of it, nitric acid will show an albuminous stratum at the plane of contact of the two liquids long after the heating test fails. But by the above management, with the picric acid solution, proportions are shown much smaller than the most skillful use of nitric acid will detect. And, different specimens of very slightly albuminous urine will react very differently with both these tests, but the picric acid seems to be the most constant of the two in its indications. This more troublesome and delicate way of using the picric acid is only needed when the circumstances require that doubt should be set at rest.

When the indications given by picric acid need confirmation, as will sometimes be the case, and are beyond the reach of heat or nitric acid, the solution of iodohydrargyrate of potassium, called Tauret's Test, or the potassio-mercuric iodide test, is said to be as good as any, but there is a choice of several.

After the foregoing pages were written, a very able article on the "Quantitative Estimation of Albumen, by George Oliver, M. D., Lond., M.R.C.P.," appeared in *The Practitioner* of February, p. 91, *et. seq.*

Dr. Oliver, whose familiarity with his subject is well known, proposes to determine the amount of albumen present in any specimen of urine by precipitating it with a given test and then diluting it until a standard degree of opacity is reached.

A measured quantity of the urine is taken, and the albumen is

precipitated,—he thinks preferably by a potassio-mercuric iodide (iodohydrargyrate) test-paper. The degree of opacity thus produced is determined by the visibility of printed lines of different thickness as seen through the opacity,—each line, or group of lines, indicating a nearly definite percentage, and the opacity being reduced by a fixed rate of dilution until the lines are visible through it, and then the amount of albumen present is calculated upon the amount of dilution required to bring it to the known standard opacity.

The requisite appliances for this method are: first, a graduated test-tube of an exact size and thickness of glass, and of clearness of glass, and Dr. Oliver prefers a flattened tube for obvious reasons. Next, a carefully prepared test-paper, either of the iodohydrargyrate, ferrocyanide or picric acid, and the first of these is preferred,—and the one preferred should be of definite and uniform strength, and be adhered to. Next the standard groups of printed lines, to be used as test-type are used. These lines must be prepared by a standard, and Dr. Oliver makes his standard from the albumen from blood serum. A solution of this albumen of known percentage strength is precipitated under carefully prescribed conditions, and fractionally diluted to the different degrees through which the lines of different thickness can be seen, so that each thickness of line corresponds to a definite percentage of albumen.

It is impossible to give an adequate idea of this paper by such a mere outline sketch, and it should be carefully read and re-read in order to do justice to it. The method is, however, somewhat complicated, and all the requisite appliances require a skill and accuracy in preparing them that is not often obtained by the physician. He must therefore depend upon others to make them up for him and trust to having them correct, since he has no easy means of testing their correctness.

When fully understood and carefully applied many of the difficulties and much of the complication will doubtless disappear, as in all processes wherein a want of familiarity with similar processes gives the idea of complexity.

It seems doubtful, however, whether the use of the balance and weights, as described in the first part of this paper, be not the simpler and the better plan, where the degree of accuracy aimed at by Dr. Oliver is to be attained. If it be objected that the use of the balance and weights in the way described does not reach the very low

proportions of albumen estimated by Dr. Oliver's method, the answer is that weighing even with a moderately sensitive balance may be easily made to reach the smallest proportions with useful precision by the simple proceeding of evaporating the acidulated urine at low temperature before testing.

For example, if 120 c.c.=4 fluidounces of the urine be evaporated in a capsule until when filtered into the test-tube and the capsule and filter washed in, the whole will measure about 30 c.c., and this be treated as described, any proportion can be easily weighed, down to that of normal albumen. If the capsule be set in a place that is simply warm, the water will evaporate off from 120 c.c. in six or eight hours.

One thing is very certain, however, and that is that no method worthy of consideration or trust need be expected that does not require time and care, and a fair degree of experience with it, in order to be even moderately successful. And that method which is best learned, if based on correct principles, is always most successful.

THE ALCOHOL QUESTION BEFORE CONGRESS.

During two or more years past Congress has wished to relieve the industrial uses of alcohol from tax, and to tax only that consumed as a beverage; but the difficulties to be met in such a discrimination have appeared to be practically insurmountable, and it may be very safely said that the more closely they are sought for and the more carefully they are investigated the more Congress will hesitate before attempting any such discrimination.

This writer was actively concerned in the investigations made with a view to the enactment of the present Spirit Laws, and was present at many of the examinations and hearings and consultations upon which the present law is based, and has been in familiar daily contact with the subject and with the law ever since that time ; moreover, he is a large user of alcohol for industrial and medical uses, and knows and feels in daily practice the enormous disadvantages of the tax to so many industries of the nation, and hence the desirability of relief. But he knows also that any relief by any such discrimination is practically impossible—first, because in a country like this it would be simply impossible to prevent

large quantities of untaxed spirit getting into beverages; and second, the impossibility of any definition of a beverage which should be definite enough for the purposes of a law. Everybody knows what an alcoholic beverage is, and yet when the dividing line is to be found between these and foods and drinks which naturally contain the products of the chemical changes of sugars and starches, nobody can find it or lay it down in a law so that it could not be easily evaded; and, on the other hand, when it became necessary to lay down a clear and definite dividing line between alcoholic beverages and medicines it would be no less impossible. For example, are the now famous Plantation and other bitters and tonics spirit beverages or are they medicines? What are the Beef, Wine and Iron preparations, and all the fashionable elixirs, etc., which consume hundreds of thousands of gallons of alcohol annually? If all these be admitted to be either manufacturing industries or medicines, then they would still farther enormously increase this form of genteel tippling of the nation, and extend it from the pharmacies and the variety stores to the saloons and bars, and thus defraud the revenue from alcoholic beverages.

If they be decided to be alcoholic beverages, then it would only be necessary to start a new crop and call them Tinctures or Extracts to get them classed as medicines. While if alcoholic medicines are to be classed as beverages and taxed, how is an alcoholic medicine to be strictly defined?

It is only necessary to refer to the everlasting litigation over tariff definitions to show that in proportion to their vagueness and indistinctness evasions become frequent and successful.

All this has been attempted, and under some forms of national government has partially and imperfectly succeeded, but would no more succeed here than would the forms of government which there yield the partial success.

Congress having seen all this, has wisely declined through many years to attempt any such discrimination, but has now, within the past two or more years, been considering and investigating a plan of another kind for relieving the industries from the spirit tax, and it now seems probable that either the spirit tax will be entirely abandoned, or some form of methylated spirit will be permitted free of tax.

The first proposition is one of finance entirely, and is for the statesman alone. If the finances of the nation will admit it, the

tax will doubtless be abolished, for it never did the least good for the morals or the ebriety of the nation. It was simply a war measure to raise revenue from an artificial substance, of which probably two-thirds of the total production was then used as a luxury which could easily be dispensed with if the consumer desired to avoid the tax. Now, with the twenty years progress of the arts and industries of the nation the production has been very largely increased, and the proportion used in the arts and industries has also increased so largely, even despite the enormous tax, that in all probability it has reached one-half of the total production. Hence the present situation seems to be, that in order to reach and tax one-half of the production of an enormous industry, the other half is taxed to the enormous extent of nearly six times its original value; and this enormous taxation not only embarrasses and retards the progress of thousands of industries, but renders hundreds of other industries, which might be started, impossible. *

So important, therefore, is it to the general good of the nation to abolish this tax entirely that it will doubtless be abolished at the earliest possible moment. And as this time is strictly a question of finance it would seem eminently wise and good to make it now, even if it were necessary to the revenue to re-impose duties on tea and coffee. Because tea and coffee are not necessaries of life,—taxes upon them were easily borne and easily and cheaply collected, and they enter as basement material into no industries as spirit does.

* Any estimate of the proportion of spirit distilled from grain or sugar which is consumed in the arts and manufactures, in comparison with that which is drank as spirit—excluding malt liquors—must be mere guesswork, and yet familiarity with the subject and a little rough calculation may make some guesses better than others. Within the area of two miles in a populous city there are, say, four large users of spirit for manufacturing, whose aggregate may be about ten barrels of alcohol a day. The small sales by druggists and pharmacists within the same area will require at least as much—say a total of twenty barrels a day. Each barrel of alcohol contains about as much spirit as two barrels of whisky or rum, and each two barrels of whisky will contain about 3,600 average drinks, three of which drinks a day would be poisonous and destructive to the average man. (See Parkes *Manual of Hygiene*, fourth edition, p. 277.) Hence it requires about 1,200 men to consume the spirit equivalent to one barrel of alcohol a day, and twenty barrels a day would require a drinking population of 24,000 men, in an area of two miles, and they must drink three times a day, to the average total of nine-sixteenths of a pint of whisky each, or nearly twenty-five per cent. more than has been decided, on good authority, to be the poisonous dose when taken daily. The number of drinking places within such an area were roughly estimated, and it was hardly supposed they could reach this daily consumption of spirit.

Untrustworthy as all such calculation is, it is about the best that can be done with such a question, and both care and pains have been taken to avoid any gross exaggeration in the estimate that not more than one-half the distilled spirit produced is drank in a way to justify the continuance of a tax. There is a large proportion drank which is undoubtedly a food, and has no relation to vice or crime, and yet this part is taken in in making the above estimate.

As an example of how the alcohol tax bears upon one large class of industries, take the instance of ether. It can be made only from alcohol. It is almost as important a solvent in the arts and manufactures as alcohol is, but for a different set of substances and a different set of uses,—as different from alcohol in its uses as alcohol is from water, and with as many and as important advantages over alcohol. With the present tax on alcohol it costs here now say about 60 cents a pound when of a quality adapted to the arts and manufactures. This cost is prohibitory to all but a few finer uses, and so enhances the cost of these few products that in turn their uses are hindered and restricted.

Contrast this with the condition of this same interest in countries where manufacturing alcohol is free from tax. Instead of $2.20 per gallon alcohol costs, as it did here before the tax, 36 to 40 cents per gallon, and ether, as one of its products, instead of 60c. per pound, costs 12 to 15c. Under these circumstances it is not difficult to understand the multitude of new uses in the industrial arts that are annually developed under the stimulus of cheap solvents, which would otherwise remain undeveloped, or be developed at such higher and obstructive cost as would limit the use. In this country, with its greater inventive genius and its constant greater strain for progress in the arts and manufactures, the greater advantages of having free alcohol can be easily seen. Instead of the combinations of alcohol makers to restrict the production to a fraction of their capacity in order to maintain prices, and instead of the bonded warehouses crowded with spirit, and the clamor for lengthened time,—and instead of the limited and restricted uses, there would, in a year or two, be again the former activity in this interest with all the advantages and improvements of the past twenty years to stimulate it, with the result of still cheaper and better alcohol than before the tax. With the vast expanse of land for the cheap production of corn, and the enormous distilleries for its conversion into spirit and cattle food, this country could, and probably would, make alcohol, and its products and educts, so well and so cheaply as to supply a large part of the world as it does with the parallel industry of grain and flour. The larger the scale upon which corn is grown the more economical and more profitable the cultivation, and thus the benefit of free alcohol would reach the farmer. The larger the scale upon which alcohol is made the more economical and the more profitable that industry becomes, and thus that industry

is benefited, and cheaper and better alcohol supplied. Then the more alcohol made the more cattle food produced and the more cattle fed upon the residue, and the more meat and leather economically supplied, so that it is very easily seen how very far-reaching this alcohol tax is upon the economies of the nation, and at what expense the revenue from it is raised. If the revenue costs more than it is worth, it is not a political economy, and will doubtless be abandoned or be substituted from other sources.

The only form of relieving the arts and manufactures from this spirit tax, which has thus far reached the form of a proposed law, is a bill introduced into the House of Representatives and referred, which proposes to exempt from duty any spirit to which a definite percentage of methyl alcohol has been added, leaving the present law and all its appliances still in force for all clean spirit. The theory upon which this proposed law is based is simply that by adding a certain amount of methyl alcohol or wood spirit to ordinary spirit or alcohol it is rendered so disagreeable to the taste that it cannot be drank, or be used in beverages, but that such addition does not prevent its being used for manufacturing and industrial purposes. Hence that alcohol or spirit for industrial purposes will be freed from tax, while that which alone can be used for drinking will still pay the tax.

Supposing this plan to be entirely effective, as designed, and supposing the proportion of alcohol drank be one-half or even two-thirds of the total production, the whole machinery and expense of the present law would be required to yield one-half or two-thirds the revenue it now does ; for the same, or even larger and more expensive appliances would be required to prevent evasion and revenue fraud.

But there are other and more serious objections. The proposed law proceeds on the theory that this methyl alcohol once added to the clean spirit permanently and irrecoverably spoils it for drinking purposes. This is a great fallacy that should be clearly recognized at the start, for the methyl alcohol can be taken out with comparative ease, and the proposed law acknowledges this by forbidding its being taken out, and providing a penalty against taking it out. To free this methylated spirit from the methyl, and clean it so as to be used as a drink is neither a difficult nor an expensive process, and this cleaning would be very sure to be done in more ways than one, and in ways that would render detection almost impossible. If the

methyl alcohol itself be pure and clean its taste and odor in the spirit would not be objectionable to a large class of spirit drinkers, and in some grades of spirit it would not always be easy to tell whether it was present in the required proportion or not, and very simple processes,—short of the more complete one of distillation,—would be applied that would so far clean the spirit as to render it acceptable to a large majority of spirit drinkers. Thus with the utmost vigilance and the most perfect detective system, the law would, beyond doubt, be seriously evaded, and the revenue defrauded.

And next as to the relief afforded to the arts and manufactures. There is probably not a single use to which alcohol is put that would not be more or less obstructed and hurt by the presence of the methyl,—just as every adulterated substance is injured by the adulteration,—while in a very large number it would be more objectionable than in drink ; and for a still larger number of the better and more important uses methylated spirit could not be used at all. In all such its use would be prohibited quite as surely as for drinking purposes, and hence this larger and better class of uses would not be relieved by the plan, but would have to use taxed spirit, or else, in common with the drinking interest, unlawfully take the methyl out.

Doubtless many manufacturers would buy the methylated spirit, and at an expense not exceeding two or three cents a gallon would clean it for their own purposes, taking the risk of detection and the penalty, and thus be relieved of the tax, and yet get clean, good alcohol cheaply. With a not uncommon disregard for law, and indifference to crime, and with sufficient cunning and care, such practices could be easily carried on to any extent, and so long as the cleaned spirit was used strictly for arts and manufactures it would be argued that the intent of the law would be fulfilled and no harm done. But as it would be quite impossible to confine such clean spirit to lawful uses, such practices could not be permitted if discovery of them was possible.

In short, the general effect would be that the honest manufacturer, who respected and obeyed the law, would not be relieved from the tax, because he could not properly use methylated spirit, while the unscrupulous one, and all the rogues uncaught, would be relieved. The business of the honest man would suffer, and his profits be small, because obliged to compete with the dishonest one, whose profits would be very large, thus offering a direct premium for crime.

Thus the law would, in practice, not relieve those whom it was intended to relieve, but would benefit only the dishonest of the class which is now so seriously embarrassed by the tax.

Again, it is not conducive of true economy and fair dealing to attempt by law to damage the purity of, or to spoil or defile any substance for any purpose, and all such attempts must lead to loose principles of action and to various forms of fraud.

Methylated spirit would be used instead of clean spirit wherever its use could be concealed, even though quite unfit for such uses, as, for example, in medicines. Alcohol, as a solvent and vehicle, is of extreme importance in making medicinal preparations, and many thousands of gallons are annually used for such purposes. As methylated spirit would be quite unfit for such uses this industry would not be relieved at all, but would be much damaged by the clandestine use of the adulterated instead of clean spirit.

Good ether could not be made from methylated spirit unless the law be first broken by cleaning the spirit; neither could good chloroform be made from it, and therefore these industries would not be relieved, but would be damaged by offering temptation to the unscrupulous either to break the law by cleaning their spirit or to make impure and debased products.

Finally, if any such line of investigation as that here sketched be carried out to its rational conclusions there is no danger of Congress ever adopting any such propositions as measures of relief, since the more thoroughly the subject is examined in all its complicated bearings, the more sure will be the conclusion that the present law should remain undisturbed until the tax can be entirely abolished; and that it should be abolished at the earliest possible moment.

THE PHARMACOPŒIA OF 1880.

(Review Continued.)

ACIDUM TARTARICUM.

TARTARIC ACID.

$H_2C_4H_4O_6$; 150.—$2HO, C_8H_4O_{10}$; 150.

Nearly or entirely colorless, transparent, monoclinic prisms, permanent in the air, odorless, having a purely acid taste and an acid reaction. Soluble in 0.7 part of water and 2.5 parts of alcohol at 15° C. (59° F.); in 0.5 part of boiling

water and in 0.2 part of boiling alcohol; also soluble in 36 parts of absolute alcohol, in 23 parts of ether, and in 250 parts of absolute ether, and nearly insoluble in chloroform, benzol and benzin. When heated for two hours at 100° C. (212° F.), the crystals do not lose more than a trace in weight. On ignition they should not leave more than 0.05 per cent. of ash. An aqueous solution of 1 part of Tartaric acid in three parts of cold water, when mixed with a solution of one part of acetate of potassium in 3 parts of cold water, followed by the addition of a volume of alcohol equal to the whole mixture, yields a white, crystalline precipitate. If, after standing two hours at the ordinary temperature, the liquid is separated by filtration and the precipitate well washed with diluted alcohol and dried at 100° C. (212° F.) in an air-bath, it should weigh between 1.25 and 1.26 parts.

A concentrated aqueous solution should not be blackened, at the line of contact, by the careful addition of test-solution of hydrosulphuric acid (lead and copper). If the crystals have left, on ignition, some ash (see above), this ash should not turn blue by treatment with a few drops of water of ammonia (copper), nor should the further addition of one drop of test-solution of sulphide of ammonium cause any black coloration (lead, copper, iron). 10 C.c. of a concentrated solution should show no precipitate within five minutes after the addition of 1 C.c. of test-solution of chloride of barium with an excess of hydrochloric acid (sulphuric acid).

To neutralize 3.75 Gm. of Tartaric Acid should require 50 C.c. of the volumetric solution of soda.

The above description and tests apply to tartaric acid in crystals, a form in which the pharmacist and physician, and even the druggist, rarely sees it. As it is used only in powder so it is commonly sold only in that state, and all the tests apply to it equally well in powder. Not one of the tests is too severe, and they will all apply to the market article from any of the two or three principal manufacturers, provided it has not been adulterated in second hands.

But there is a very considerable difference in the powdered tartaric acid of the markets, which is not alluded to or reached in the above testing. Some powder of the same manufacturer is more hygroscopic than other and becomes hard and lumpy in the boxes. It almost all "cakes" somewhat after having been packed, but the lumps are much harder and more difficult to break up at some times than at others. The reason for this, as reached by the writer by inference, and a very limited experience in crystallizing it, is that as the mother liquors are evaporated down from one crop of crystals after another, a small part of the acid becomes decomposed and changed into a mucous-like substance, which finally becomes so large in quantity as to prevent crystallization. The different crops of crystals may be equally well washed by the manufacturer, and

yet some of this uncrystallizable matter will still remain in the interstices of the crysals, and just in proportion as it remains will the powder be clammy and dead, and be liable to cake. The first crop of crystals always yields a nice lively powder, which does not attract the moisture of damp weather, and scarcely cakes at all. Even when two, or perhaps even three of the first crops are ground together, the product is of fair quality in this respect; but the crystallization should not be pushed farther than this before the mother-liquors are precipitated as tartrate of lime, and this washed clean from this objectionable ropy matter.

ACONITUM.

ACONITE.

The tuberous root of *Aconitum Napellus* Linné (Nat. Ord., *Ranunculaceæ*).

From one-half to three-quarters of an inch (12 to 20 millimeters) thick at the crown; conically contracted below; from two to three inches (50 to 75 millimeters) long, with scars or fragments of radicles; dark-brown externally, whitish internally; with a rather thick bark, enclosing a star-shaped pith, about seven-rayed; without odor; taste at first sweetish, soon becoming acrid, and producing a sensation of tingling and numbness.

Preparations: Abstractum Aconiti. Extractum Aconiti. Extractum Aconiti Fluidum. Tinctura Aconiti.

This description applies very well indeed to some parcels of Aconite root, but there are few drugs which, while retaining a general form, vary more in size, color and thickness of bark, in different parcels met with in the markets. The roots in the same parcel vary very much also in size, surface, and internal structure. Many roots in every parcel will not be over 1 to 1½ inches in length, and while a large proportion are very much wrinkled longitudinally, a few are quite smooth. These smooth roots are absent entirely from some parcels, and are not very numerous in any. They break with a solid, starchy fracture, and commonly have a very thin bark. The wrinkled roots are more spongy internally, and some are very light and porous, doubtless from having been in a very succulent condition when gathered. All these varieties may be very strong or very feeble to the taste, for the appearance bears very little relation to the activity of the root. Some parcels are much more stalky than others; that is, have more of the compara-

tively inert stalk cut off with the root, and in this are of course objectionable, yet many parcels that are quite stalky are to be preferred to those which are better trimmed, on account of superior activity. The greatest difference, however, in different bales is in the taste, or rather in the aconite impression upon the tongue and lips, and upon this the writer has long relied in selecting for purchase. Some years ago he published the method of testing by taste, and at that time stated that, with care in selecting, parcels could be had which when each root of a handful sample was broken in the middle, and a very small piece from the point of fracture was chewed between the front teeth in contact with the tip of the tongue for a few moments, and was then discharged, eight out of ten of the roots would give the characteristic aconite tingling in some degree within ten or fifteen minutes. He can now state that parcels are easily had, though at a higher price, every root of which will give a strong sensation from a very small particle. This has made him revise the test within the past two years. As it comes from shipboard, or from storehouses, it is commonly tough enough to be cut across with a sharp knife without going to dust as it does when dry. A very thin slice cut across from the middle of the root will weigh about a centigramme, or a little over one-sixth of a grain. This, if cut in ten pieces of nearly equal size, each will weigh about a millegramme, or the sixty-fifth of a grain. One of such pieces, taken between the front teeth and chewed in contact with the tip of the tongue with saliva enough to wet it, for about one minnte, should give the aconite impression, not strongly, and not amounting to tingling, but yet a distinct impression which, when realized a few times, will always be recognized. There is no need of this cutting and weighing more than once, and that only to see how small a piece to take for the test, and there is a great advantage in taking so very small a piece, because the impression from it is so faint that it soon passes away, and admits of another root being tested in the same way in half an hour or so. If the piece be larger and the impression strong, it will last for two hours or more, and thus only a very few pieces can be tested in a day. At best it is a slow process, but well worth applying in the interest of accurate medication by a drug so important. Few pharmacists or physicians ever see the root, but only get the powdered root. The powder should be tested in the same way, taking about the same quantity on the tip of the tongue, and bruising and softening it with the teeth so as to get out the active principle.

Aconite root is not sweetish as described by the Pharmacopœia, but is distinctly bitterish, but the taste proper is always faint. Some roots are tasteless, or so nearly so that no very distinct taste is recognized, and yet such roots may in a few minutes give a very decided impression.

The same method of testing as applied to the preparations of aconite was described at page 126 of this series of pamphlets.

ADEPS.

LARD.

The prepared, internal fat of the abdomen of *Sus scrofa* Linné (Class, *Mammalia;* Ord., *Pachydermata*), purified by washing with water, melting and straining.

Lard should be preserved in securely closed vessels impervious to fat.

A soft, white, unctuous solid, of a faint odor free from rancidity, having a bland taste, and a neutral reaction. Entirely soluble in ether, benzin, and disulphide of carbon. Sp. gr. about 0.938. It melts at or near 35° C. (95° F.) to a clear, colorless liquid, and at or below 30° C. (86° F.) it is a soft solid.

Distilled water, boiled with Lard, should not acquire an alkaline reaction (abs. of alkalies), nor should another portion be colored blue by solution of iodine (abs. of starch). A portion of the water, when filtered, acidulated with nitric acid, and treated with test-solution of nitrate of silver, should not yield a white precipitate soluble in ammonia (abs. of common salt). When heated for several hours on the water-bath, under frequent stirring, Lard should not diminish sensibly in weight (abs. of water).

Preparations: Adeps Benzoinatus. Ceratum. Ceratum Resinæ. Unguentum.

The above description and tests are full and sufficient, but they will very rarely be answered by any lard that can be bought. Most pharmacists will doubtless have had the same experience in this as the writer, and many years ago he had to give up all attempts at buying lard that was fit for pharmaceutical use, and then it was quite a surprise to find how easy it was to make it.

"Leaf Lard," so called, which is the harder fat from the omentum and around the kidneys, is bought fresh, and in winter time only,—is cut in small pieces and well-washed with cold water and drained, and the water absorbed by cloths as well as practicable. It is then heated on a water or steam bath to about 40° to 50° C. =104° to 122° F. only, and the melted fat pressed or wrung out in cloths. This

melted lard, run at once into tight tin vessels, is perfectly sweet and good, and in a cool place, well protected from air, keeps sweet almost indefinitely. If to be long kept, it is worth while to run a thin layer of melted tallow onto the surface of the hardened lard,—the cake to be taken off and used as soap-fat when the lard is to be used.

This is the only way known to the writer to get lard that will withstand the above Pharmacopœial tests, and no lard is fit for medicinal use that will not answer to them, for not unfrequently patients are made worse by applications with lard as a vehicle, by the use of inferior lard.

But the time during which lard is to be used for medicinal purposes is almost past. Already the soft paraffins as the Petrolatum, Vaseline and Cosmolin have almost replaced it with many and very great advantages, and its lifetime in pharmacy will be lengthened by the Pharmacopœia having, properly enough, adhered to it for certain uses. But now that the soft paraffins are being made entirely pure and colorless, and so much like very fine lard in appearance and sensible properties, as well as in the protecting and emollient effects, their substitution for lard will be still more rapid, and with still greater advantages over it. Not the least of the advantages of those white or colorless soft paraffins, is that they do not become rancid, and thus do away with the necessity for the officinal Benzoated Lard entirely.

ÆTHER.

ETHER.

A liquid composed of about 74 per cent. of Ethyl Oxide [$(C_2H_5)_2O$; $74 - C_4H_5O$; 37] and about 26 per cent. of Alcohol containing a little water. Sp. gr. about 0.750 at 15°C. (59°F.).

Ether should be preserved in well-stopped bottles or in soldered tins in a cool place, remote from lights and fire.

The properties of Ether are given under Stronger Ether (see *Æther Fortior*). It dissolves in about 5 times its volume of water.

Tested, as directed under Stronger Ether, the reaction should be neutral; on evaporation it should leave no fixed residue, and the last portion should have not more than a very slight foreign odor; a volume of 10 C.c. upon agitation with an equal volume of glycerin, should not be reduced to less than 7.5 C.c.

This is but a useless relic of former Pharmacopœias, and might well have been dismissed. It is very easily made, when diluted or

weakened ether is wanted by adding to the 73 or 74 parts of the Stronger Ether 27 or 26 parts of officinal Alcohol. But it is rarely if ever wanted, and answers no pharmaceutical or medical purpose, which is not better served by the Stronger Ether. Some thirty or thirty-five years ago this article was about the best that could be done in the way of ether-making, and therefore it was *the* Ether of the markets, but the progress in arts and manufactures has now left it far behind. It first gave place to the "Washed Ether" of the markets, then this gave place to the "Concentrated Ether," and finally there was a kind called "Washed Concentrated Ether," and that is perhaps now the commercial representative of the Stronger Ether of the Pharmacopœia.

ÆTHER ACETICUS.

ACETIC ETHER.

$C_2H_5C_2H_3O_2$; 88. — $C_4H_5O,C_4H_3O_3$; 88.

[Acetate of Ethyl.]

Acetic Ether should be preserved in well-stopped bottles, remote from lights and fire.

A transparent and colorless liquid, of a strong, fragrant, ethereal, and somewhat acetous odor, a refreshing taste, and neutral reaction. Soluble, in all proportions, in alcohol, ether and chloroform, and in about 17 parts of water. Sp. gr. 0.889 to 0.897. It boils at about 76°C. (168.8° F.). It is inflammable, burning with a bluish yellow flame and acetous odor.

Acetic Ether should not change the color of blue litmus paper previously moistened with water, nor leave any fixed residue upon evaporation. When 10 C.c. are agitated with an equal volume of water, in a graduated test-tube, the upper, ethereal layer, after its separation, should not measure less than 9 C.c.

Preparations: Spiritus Odoratus. Tinctura Ferri Acetatis.

This substance is peculiar in having no officinal definition. It is simply given as acetate of ethyl, but the description and tests seem indirectly to recognize that the officinal article is not expected to be wholly acetate of ethyl. Practically it always contains both alcohol and water, and the proportions in which these are present should be recognized in a definition, and checked or controlled in the description and tests as well, for this proportion it is which constitutes it good or bad acetic ether. It is perhaps attempted to be controlled by the specific gravity, but this is not a close test of strength here, and beside has so wide a range between the extremes as to be practically useless.

It is described as having a refreshing taste, but the taste is pungent and biting almost to acridity, while the odor is very refreshing. It is described as being soluble in about 17 parts of water, but this is a mistake. Absolute acetate of ethyl is given by various authorities as soluble in various proportions of water, from 7 to 12 parts, but none give anything like 17 parts, while the presence of alcohol and water in it render it more soluble instead of less so, because the alcohol, when it is washed out and unites with the water, renders the water a better solvent of the compound ether. In a careful, though not critically accurate determination with the well-washed ether, it dissolved in 11.86 parts of water, at about 18°C. This is supported by such authorities as Allen, Mohr, and Becker, while all the other authorities give it as more soluble, as in 7, 8, and 9 parts of water.

The s. g. given is "0·889 to 0·897," and these specific gravities when no temperature is given are to be understood as being at 15° C. = 59° F., but whether compared with water at this temperature or at maximum density, is not known. Authorities give various densities for the pure acetate of ethyl.

Kopp gives ·91046 at 0° C.; Becker, 0·903 at 17° C.; Allen, ·9146 at 0° C. and ·8981 at 15° C.

A bottle of the ether made by a well-known German maker, labelled absolute and chemically pure, and sold at a correspondingly high price, and four bottles of the four principal makers of this part of this country, were weighed by the writer with the following results:

	COMPARED WITH AN EQUAL VOLUME OF WATER—				
	at 4° C.	at 15.6° C.	at 4° C.	at 15.6° C.	at 4° C.
Weighed	at 4° C.	at 15.6° C.	at 15.6° C.	at 25° C.	at 25° C.
German.....	·91400	·90065	·90130	·89072	·88970
No. 1.....	·90494	·89450	·89294	·88260	·88158
No. 2.....	·87442	·86398	·86341	·85910	·85861
No. 3.....	·85605	·84593	·84536	·83723	·83675
No. 4.....	·89013	·87969	·87905	·87092	·86992

The first and second columns being equal volumes weighed at the same temperature are true specific gravities by the two common standards of temperature, and therefore of volume; but in the other three columns the ether being weighed at one temperature compared with water at another, the specific gravities are apparent. To convert apparent into true specific gravities a correction for expansion of glass must be applied, for the figures and details of which

see page 354. But apparent specific gravities are all that are needed, and all that are commonly used in pharmacy, and all the pharmacopœial specific gravities are supposed to be apparent, except where obtained from corrected tables, though this is nowhere stated to be the case. It is indeed quite possible that the Pharmacopœia Committee may not have adopted the very common European standard of water at its maximum density, namely, 4° C., and that when they say that their specific gravities are to be understood to refer to a temperature of 15° C. (59° F.), they mean that both the standard and the liquid weighed are to be at that temperature, and if so their specific gravities are true specific gravities, but with a different and newer standard than the two older ones of 4° C. and 15.6° C. = 60° F. If this be so, it still more confuses the important subject of accuracy in specific gravities.

It will be seen that the s. g. of the German acetic ether is about that given by authorities for the absolute acetate of ethyl, and on examination this ether appeared to be free from water and almost free from alcohol, containing probably less than 1 p.c. It therefore served a very good purpose for comparison.

Beside this, only one of the market specimens, No. 1, comes within the range of pharmacopœial specific gravities, but it is still considerably below the officinal maximum. The others are all much lower and indicate weaker and more dilute ether, so that it is probable that nine-tenths of all that is made and sold in this country is far below the officinal range of s.g., wide and indefinite as that is. The s.g. of the diluent here being so near to that of the ether itself, small differences in density indicate much larger differences in the relative proportions of the ether and its diluent.

Hence, although s. g. is a very useful indication of strength of acetic ether, it is not a very sensitive test practically, and cannot be relied on alone. But it should be much more definite than in the Pharmacopœia, because the range there permissible embraces a dilution of more than 25 p.c.

All the specimens, excepting the foreign one, were neutral to litmus paper, and the exception was only very slightly acid,—so slightly as to require a neutral litmus paper to detect the acidity. Paper that was entirely blue did not detect it, therefore it was not an exception when the "blue litmus paper" of the Pharmacopœia is literally taken.

It only requires a slight exposure to air for any of the stronger

ones to show an acid reaction to blue litmus, and a bottle that is in use and is half empty will, sometimes at least, and probably always, give an acid reaction. The weaker ethers, or those which have much alcohol in them (for this is the diluent in these) do not become acid on short exposure, and probably not during ordinary use. All authorities state that this ether is easily split, and that any mixture of it, with water or dilute alcohol present, undergoes change with liberation of the acid, but with absolute alcohol, or even very strong alcohol, the splitting does not occur, or occurs very slowly. Hence the previous wetting of the litmus paper, as directed, has something to do with the acidity, for if the wet litmus paper be looked at while immersed in the ether, in a test-tube, the change is seen to be progressive, but perhaps not quite as rapidly so as when exposed to the air. But all such faint degrees of acidity are practically unimportant for medicinal uses.

The Pharmacopœia finally says: "When 10 c.c. are agitated with an equal volume of water, in a graduated test-tube, the upper, ethereal layer, after its separation, should not measure less than 9 c.c."

It is this test which gives importance to the error in the solubility test. Whether the ether was soluble in 12 or in 17 parts of water is a matter that might have been overlooked as of little importance except that it effects this test seriously, and this is *the* practically important test of quality. The foreign made sample of acetic ether, sold as being absolute, and which is probably nearly free from alcohol and water, is the only specimen the writer has ever seen that would stand this test,—and this barely stands it, although in s.g. it is much above the maximum one of the Pharmacopœia. In order to be sure upon this point it was necessary, instead of 10 c.c. to take 100 c.c. of the ether and 100 c.c of distilled water in a well graduated cylinder at 16° C. and to add water to supply the contraction. At the end there was 111 c.c. of the watery portion, and 89 c.c. of the ethereal upper portion.

Now the ether, when free from alcohol, dissolves about 3 p.c. of water, and is dissolved by water in the proportion of 1 to 12. Therefore supposing this to be absolute ether (as it was not quite) the 100 c.c. would dissolve about 3 c.c. of water and thus measure 103 c.c. Then the 100 c.c. of water would dissolve about 8.33 c.c. of the ether and become 108.33 c.c., and the balance between these solubilities support the actual result obtained. There-

fore both the practical trial and the calculation from the solubilities show that the Pharmacopœia test is a little too high for absolute chemically pure acetic ether if the test be applied at ordinary room temperatures,—and much too high for the ether of its prescribed range of specific gravity. In order to ascertain how much too high it is, and to get a practical limitation by the test, a portion of the German acetic ether was thoroughly washed to free it from the small proportion of alcohol still held by it, and in this washing it very constantly lost to the washing water about 1 part to 12 parts of water

A portion of acetic ether carefully made by the writer was also thoroughly washed in the same way, and lost at each washing just the same proportion to the water, the water saturated ether coming off each time from a well-shaken mixture of 50 c.c. each of the ether and water at 18° to 20° C., 56 c.c. watery portion and 44 c.c. ethereal portion,—or a little below the Pharmacopœia test, which would require 55 and 45.

Then a progressive series of dilutions of these well washed ethers was made for testing, and as the two series ran practically parallel in these results it is only necessary to record one series.

The dilutions were made with officinal alcohol, s.g. ·820 at 15.6°C. and the contraction which occurred when the acetic ether and alcohol were mixed was made up by ether. In the last dilution this contraction amounted to 4 p.c. That is 25 c.c. each of the acetic ether and alcohol made only 48 c.c. of the mixture, and 2 c.c. of the ether were added to make the 50 c.c. The following table, however, will not be complicated by the figures for this contraction, but the quantities will be given as though there was no contraction:

Of pure well-washed acetic ether 50 c c.		and	50	c.c.	water, well shaken, separated into	44 c.c.	and 56 c.c.
Ether cont'g 5 p.c.	alcohol	50 c.c. and	50	c.c.	water "	42 c.c "	58 c.c.
" 10	"	"	"	"	"	39 c.c. "	61 c.c.
" 20	"	"	"	"	"	35 c.c. "	65 c.c.
" 30	"	"	"	"	"	31 c.c. "	69 c.c.
" 40	"	"	"	"	"	25 c.c. "	75 c.c.
" 45	"	"	"	"	"	20 c.c. "	80 c.c.
" 50	"	"	"	"	"	10 c.c. "	90 c.c.
" 55	"	"	"	"	does not separate.		

The mixture with 50 p.c. of alcohol does not separate at 16° C., but when cooled about 3° below this it separates and gives the

results 10 to 90. Reduced to the freezing point of water it gives 18 to 82, showing how great an effect temperature has upon these mixtures.

On again standing in a warm room at 18° to 20° C. it remains separated until shaken and then mixes again to a clear solution.

The above results reduced to the pharmacopœical expression of the test would be as follows:

For the pure acetic ether, free from alcohol but not anhydrous, on the close applicaion of the test, at common room temperatures, the volume separated would be.....						from	10 c.c. 8.8 c.c.
The same acetic ether containing	5	p.c.	of	alcohol.....	"	10 c.c.	8.4 c.c.
" " "	10	"		.....	"	10 c.c.	7.8 c.c.
" " "	20	"		.....	"	10 c.c.	7.0 c.c.
" " "	30	"		.....	"	10 c.c.	6.2 c.c.
" " "	40	"		.....	"	10 c.c.	5.0 c.c.
" " "	45	"		.....	"	10 c.c.	4.0 c.c.
" " "	50	"		.....	"	10 c.c.	2.0 c.c.
" " "	55	"		.....	"	10 c.c.	none.

and this latter proportion does not separate even at 0° C.

By these results it will be seen that for this range of mixtures up to about 40 p.c. dilution, each 10 p.c. dilution by volume gives a difference of ·8 c.c. or 8 p.c. by volume, and that, therefore, each 1 p.c. of alcohol present in the acetic ether is equal to ·08 c.c. in the test, and hence the testing to be very useful must be done in a tube graduated to one hundredths of a c.c., and in a tube so narrow it is very difficult to shake the mixture so as to wash the ether well. Still the test will answer a very good purpose until manufacturers put a much better product into the markets.

The five specimens used for this paper, when subjected to this test, gave the following results:

The German	" Absolute C. P."	acetic	ether,	from	10 c.c.	gave 8.8 c.c.
Market Specimen,	No. 1,	"	"	"	10 c.c.	" 7.0 c.c.
"	" No. 2,	"	"	"	10 c.c.	" 1.4 c.c.
"	" No. 3,	"	"	did not separate at 0° C.=32° F.		
"	" No. 4,	"	"	"	"	"

It will from this be seen that the best market specimen contained about 20 p.c. of alcohol. The next best about 50 p.c. of alcohol, and the other two specimens more than 50 p.c., but how much more was not determined, both being out of the range of this test, yet the No. 1 specimen was well within the range of the Pharmacopœia

specific gravities. This test is, therefore, not only much too high, but does not agree at all with the s.g. test, since a market specimen may answer one important test well, and the other important one not to all.

In the present state of the market, therefore, and in consideration of the present uses of acetic ether, the Pharmacopœia should have limited its s.g. to ·895 to ·893, and its solubility test to not less than 7 c.c. Then the two would have been more definite, and would have been in accord.

A curious circumstance often noticed casually before this, came up again in these investigations. Ethereal dilutions with alcohol and water, when the product of distillation, are much more difficult to separate sharply and quantitatively than when made by simple extemporaneous admixture. That is, the alcohol which is left in the acetic ether by the manufacturer in the distillation and purification, and which was simply present in excess when the ether was formed from a part of it, is in a much closer combination with it, and is much harder to separate from it than when the ether and alcohol are mixed in definite proportions.

Instances of this are found in sweet spirit of nitre, spirit of chloroform, etc. In all such it is difficult to apply this method of testing by washing out and measuring the ethereal liquids.

This addition to the Pharmacopœia, although therapeutically not very important, is still very useful. Acetic ether is a powerful as well as a very agreeable diffusible stimulant and antispasmodic, and it is also a useful carminative. Ten or fifteen minims of it dropped upon a tea-spoonful of crushed ice and swallowed will often avert a sick headache if used at the onset. But it is chiefly as a rather important adjuvant that it is most useful. Added in equal volume to cologne it renders that spirit much more efficacious in the sick room, and more refreshing under any circumstances. Added to aromatic spirit of ammonia when this is given on crushed ice, either with or without a few drops of chloroform, the mixture will control many forms of sick headache, and prove an excellent restorative in threatened syncope. Added in equal volumes to tincture of asafetida, or in larger proportion to fluid extract of valerian, it much improves their antispasmodic effects, and renders the dose much less disagreeable. As an addition to the usual means of controlling temporary and recurrent hysteria it is said to be very useful, and it is

also a pleasant and useful addition to fluid extract of ginger and other carminatives.

It is also an excellent and refreshing corrigent to the odors of sick rooms by allowing it to evaporate in small quantities from clothes; or it may be sprinkled upon bedding, carpets, etc. When patients tire of other correcting odors used for such purposes, this one is often very refreshing and wholesome, and such uses are by no means unimportant.

It is an anæsthetic, and although not a very powerful one, the inhalation of the vapor has doubtless much to do with the relief obtained by its free application externally in neuralgias, rheumatisms and other local pains. On the authority of Dorvault, the French use it only by external application, and it enters into one or more of their popular embrocations.

The anæsthetic effect, as well as the stimulant, is also useful where it is smelled from a vinaigrette for the relief of headache, or as a refreshment after fatigue.

The vapor is very diffusible, and therefore the odor is soon dissipated by the diffusion, and it is most agreeable when in small proportion.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. MAY, 1884. No. 3.

CONSTIPATION.

Perhaps the best working hypothesis, in relation to health and the departures from it, that is fairly deducible from the drift of modern investigation, is to regard all diseased conditions as being penal,—that is, as penalties or punishments for broken laws :—and then to remember that the judges and juries which try the infractions of health laws, and impose the penalties, are out of reach of sympathies and emotions, and cannot be tampered with ; and that the decisions are final, because there is no court of appeal nor pardoning power; and, finally, that the penalty is in degree exactly proportionate to the extent to which the laws are broken.

Contagious and hereditary diseases appear at first sight to conflict with such an hypothesis, but the conflict may be regarded as apparent only, since both must have originated upon a normal condition and subsequent to it, and as the progressive and cumulative result of broken laws through past ages. These are penalties adjudged upon the races of mankind and not upon the individual.

The teaching of such an hypothesis becomes plain at a glance. Find out the laws and conditions of health and conform to them, and then as the penalties are paid, and new penalties less and less incurred, suffering would diminish at the same rate, and in the progress of time practically cease.

However this may be as a broad generalization, it is undoubtedly true by experience within the limited sphere of the minor diseased conditions, and nowhere more true than in a large proportion of cases of constipation. That is, constipation is very often, if not generally, at its onset, the penalty of broken laws, and when allowed to become fixed by the tremendous force of habit it is apt to become *the* law of the economy.

It is a condition well understood, and the serious difficulties to which it leads are well recognized, and the teachings of the schools and books in regard to it are so full and sufficient that it is out of the question to say anything new about it, so that almost the only excuse any one can have for going to the subject at all now, is that there is a certain need or use for repetition which is well recognized, especially if the subject can be set in any new light.

John Wesley is said to have said: "Mistress Wesley, why do you tell that child the same thing over and over again?" "John Wesley, because once telling is not enough."

But just now it is to a partial analyses of the condition known as constipation, for the purpose of getting at a principal element, that the attention of the reader is invited.

The condition known as constipation consists in an undue accumulation of excrementious matters in the intestinal canal.

The law of health seems to be that while food is taken about three times a day, the residuary and waste portions of the food and of the tissues should be discharged once a day. If, while the food continues to be taken, the discharge be diminished or interrupted, the condition is constipation.

There are many causes of constipation, and therefore many kinds, but there is one single condition that is so common to all kinds as to be almost universal. The residuary matters of the food become so dry and hard that the means provided by the economy for their extrusion are insufficient. This dry and compact condition is, therefore, abnormal, and the causes of it have to be sought out and corrected.

It seems absurd to say that the immediate cause of dryness and hardness is want of moisture, and that want of moisture in a mass of matter previously well supplied with it is owing to undue absorption, and yet this very childish statement expresses the simple conditions in almost all constipations, and indicates clearly enough what is needed.

Physiologists teach* that the average healthy adult man takes about 2,550 grammes, or 5 lbs. 2 ounces, avoirdupois, of food (including drink), daily. Of this about 4 lbs. 1 ounce is water, and 1 lb. 1 ounce anhydrous solids. The average excrement from this, in a healthy condition, is about 150 grammes, or 5.25 ounces; of which 3.94 ounces is water, and 1.31 ounces solids. Thus, in the nat-

*See Human Physiology, by Dalton, 1875, pp. 125, 187.

ural condition about 79 p.c. of the ingesta and 75 p.c. of the residue is water, and this is the law of the healthy economy. These proportions remaining constant or nearly so, constipation can occur but rarely, if at all, and therefore, to avoid constipation the plain indication is to keep them constant; but through want of proper care and attention the proportions are liable to vary, and then the question, which embraces constipation and other abnormal conditions, becomes how and when do they vary, and how and when can the variation be corrected?

If the proportion of water in the excreta falls below 50 p.c. the muscular coat of the intestine will move the mass toward the outlet more slowly and with more difficulty than is natural, while if it falls to or below 20 p.c., as is not infrequent, the muscular power, even if normal, can hardly move it at all. Then accumulation occurs, and artificial relief becomes necessary.

Next, in natural order, comes the question: why does the proportion of water, which is necessary in the feces to render them manageable by the natural means provided, become reduced? If the proportion taken with the food be natural and constant, and the proportion excreted by the kidneys, the skin and the lungs be natural and constant, the proportion in the feces cannot be reduced, and constipation from this cause cannot occur or cannot continue. Therefore, to correct or to prevent constipation, it is only necessary to keep the food and the excretory functions in a normal condition.

The blood in health consists of about 79 p.c. water, or just about the same proportion as the food, and as this water is the solvent and carries all the material both for supply and waste, its volume must be kept nearly constant in the economy, and to keep it constant the water must be taken from any available source. Any diminution of this volume must occur either from insufficient supply from without, or from increased excretion by either the kidneys, the skin, or the lungs, or by all of these together; and within this narrow compass all the causes of ordinary constipation must be found. Then these causes fall naturally under two heads, namely: defective supply, or excessive excretion of water, and these causes may act separately or together; but when considered separately, the rare cases in which they act together will be easily understood

Insufficient supply of water or of succulent food is probably the ultimate cause of three-fourths of the cases of ordinary constipation. The appetite for liquids which, under strictly normal conditions would regulate the supply to the demand, is, under the ordinary

conditions of civilized life, largely controlled by habit, and habits are often established by thoughtless concessions to convenience. Habit has quite as much to do with the taking of food at stated times as appetite has; the latter merely coming in to decide how much shall be taken, and this decision often based upon the quality of the food and the time allotted to the process; and too much liquid taken with the food so embarrasses digestion as to cause inconvenience, and thus not only is a bad habit prevented, but a still worse habit of taking too little liquid is liable to be fallen into. So, too, with drink proper, or water taken at other than meal times. The appetite, for it is often not strong enough to break through the occupations of the time, and by habitual neglect, soon disappears altogether. Anyone who is sufficiently observant of his lesser instinctive wants will find that, after the first stages of digestion and absorption, a glass of water is particularly acceptable, and the most acceptable time will vary with the rapidity of the digestion of the individual—generally from one to two hours after the meal. Then other times for taking water will depend largely upon the amount of exercise, since these are chiefly to supply the waste by the lungs and the skin.

It has been seen above, that when the food and feces are in their natural condition, the proportion is about 17 of food to 1 of excrement, and this maintains the normal volume of circulating fluids at the health standard. Now if the proportion of 79 p.c. liquids to 21 p.c. solids in the food supply be changed to 70 p.c. liquids and 30 p.c. solids, and the excretion of water by kidneys, lungs and skin be reduced only by 6 p.c. there is still a deficit of 3 p.c. of the water necessary to keep the volume of circulating fluids at its constant quantity; and this 3 p.c. must be supplied through the natural channels,—namely, the absorbents of the alimentary canal. These absorbents have no source from which to get this 3 p.c. deficit except from the food residues remaining within their grasp, and in taking the water from these they render the mass dry, hard and unmanageable by the muscular coat, and thus establish constipation.

Whereas if the undue absorption of water from the residues of the food be prevented by a more copious supply no constipation from this cause can occur.

It then follows that a natural way of preventing undue absorption of the water from the feces is to keep up a plentiful supply from without, so that the small quantity needed to be left with the

residues in the alimentary canal to keep the feces in a pultaceous condition need not be absorbed to supply deficiencies elsewhere.

Again, the supply of water being normal, constipation occurs from any abnormal drain upon the circulation. A person being habitually overclad so promotes the insensible perspiration as to deplete the circulation, and thus call on the absorbents to supply the deficiency from the alimentary residues. The kidneys, too, may be stimulated in many ways, by errors in living, to over excretion of water, and thus in the same way cause constipation.

Their natural function seems to be to excrete just water enough to hold in perfect solution all the waste products eliminated by this channel. When they excrete more than this the loss is depletive and constitutes a kind of urinary diarrhœa. When less, the various kinds of calculi and overloaded urine constitutes a kind of urinary constipation.

Many years ago a treatment of constipation founded upon these principles was adopted hy the writer, and many times every year since he has had abundant testimony in regard to its efficacy.

His position in relation to the materia medica brings him numerous applications for medicines to cure constipation, but instead of medicines the applicants commonly get only advice based on the above mentioned principles. Then as the medicines would cost something, while neither the advice nor the water cost anything, the applicants, whether they be physicians or patients, are generally willing to try the plan. Of late, since the Sangrado treatment by *hot* water has been revived and has become so popular for all difficulties of digestion as to constitute a craze, it will undoubtedly be applied to constipation, and with results quite as good, of course, as if the water was taken cold.

The very common relief obtained in constipation from the use of the fashionable mineral waters is doubtless largely due to the water.

Persons go to the mineral springs, or use mineral waters at home, thus increasing the quantity of water taken by from one to three glasses each day beyond the previous habit, and it is not wonderful but quite natural from the above considerations that constipation should be relieved, even if the very small proportion of salines be left out of the question.

As a large proportion of the effective mineral waters contain less than one-half of one per cent. of total solids it is not difficult to understand that the water is an important, if not the most important element; while it is very certain that water alone will answer an excellent purpose in the management of constipation.

An interesting popular experiment is about to be tried which may throw some light upon this popular mineral water craze. A mercantile enterprise is on foot for putting up and selling aerated distilled water, and if money enough be spent in the advertising it may rival the mineral waters in pecuniary success at least, and will doubtless cure some constipations.

A good way,—if not the best way,—of taking water is in the form of fresh fruit, and when fruit stands get to be as numerous in the streets as mineral water stands, and dishes of fruit more common on tables at meal times, there will be less constipation. In fruit the water is so combined with mucilaginous, saccharine and acidulous elements that it is not so easily or so rapidly absorbed from the residues, and the residues of many fruits, such as the very wholesome banana, are larger and more pultaceous than from other foods. One way in which exercise is very important in the treatment of constipation is in creating an appetite for water to supply the waste by transpiration. The appetite is entirely healthful, and is proportionate to the amount of exercise, so that when the exercise is sufficient the appetite is strong enough to command attention.

The fact that purgatives are not only useless but generally hurtful in the treatment of constipation is easily understood from the above mentioned considerations. They cause a pouring into the alimentary canal from the volume of circulating fluids a considerable portion of water to dilute the feces, and at the same time increase the peristaltic action. But as this diminishes the volume of the circulating fluids even beyond the existing habit which caused the constipation, the absorbents are excited to still greater activity to re-supply the deficiency, and thus the feces are soon inspissated to even a greater degree than before.

Mild laxatives and aperients, however, are not, when properly used, liable to the same objections, and are often useful in overcoming a bad habit of absorption, and in establishing a new habit of health, but they are most effective when used in small quantities repeated daily or with each meal, and their results not looked for too early.

Finally, this rational treatment of constipation may be summed up as follows: Take enough water with the food and a large glass of water during the later stages of each digestion. Then carefully watch for an appetite for more water between meals, and satisfy it when it arises. This will cure many cases. But if the kidneys drain off this additional water as fast as it is taken, as will not un-

frequently happen, leaving the constipated condition unchanged ; this may be only for a week or two, or for a few weeks; the treatment must be persisted in, remembering that it naturally takes about as long to break up a bad habit as it did to establish it. If this be not sufficient collateral means may be resorted to, such as increase in the proportion of the laxative elements in the food,—increased proportion of fresh fruit, increased exercise, etc., and if needed the temporary but regular use of mild laxative medicines in moderate quantity, remembering that a laxative or aperient medicine is often misused so as to be a purgative and thus become hurtful. Laxatives should be taken preferably immediately after each meal, as in the case of the officinal dinner pill. Aperients should be taken largely diluted, either at bed time, carefuly avoiding too much bed clothing, or half an hour before breakfast, so as to supply the vessels with liquid and thus prevent their taking it too quickly from the food.

An important element in some cases of constipation is the inspsissation of what has been called the natural purgative—the bile. The same deficiency of liquids which inspissates the feces produces also a constipation of the liver. Sluggish hepatic secretion, hard to move, and therefore slowly and ineffectively entering the bowel at the proper time, and resulting in distended or impacted gall bladder, are then to be expected. The re-establishment of the natural law of liquid supply will often correct this condition very slowly and imperfectly, or not at all, if the kidneys be active in keeping the liquids drained off to the degree of the established bad habit. Then it is that a laxative medicine which acts by election upon the duodenum, becomes necessary. The old-fashioned dose of calomel, or the emetic, come in here in a very effective, though rather rough and unpleasant way. In the light of modern therapeutics, only a very few cases can need such treatment now, as very few are allowed to proceed to the extent of requiring it. Taken in time, as such cases now are, a mild mercurial properly combined for laxative effect, or a good preparation of taraxacum, or some proper combination of podophyllum, taken at bed-time, or night and morning for a day or two, will generally correct the condition, and once corrected properly, the normal supply of liquids will, after a while, prevent a recurrence of what never could had occurred under the laws for a healthy economy.

In short, a copious supply of water is as necessary to the internal as to the external cleanliness of the animal economy, and no system

of individual drainage and sewage can be natural or effective without it. Internal cleanliness is quite as near to godliness as external, and is as much the law of health; and as a law it has been quite as long known—quite as often broken, and with the same penalties. The redoubted Sir John Falstaff, in one of his farthest reaches of repentance, says: "I'll purge and leave sack, and live cleanly as a nobleman should do."

ABSOLUTE ALCOHOL.

It appears to be very certain that no alcohol has as yet been rendered entirely anhydrous, and therefore the term absolute as applied to any yet made is not strictly correct. For all practical purposes, however, it is a very convenient term by which to designate a rather indefinite substance, but one now applied to a great many important uses, and therefore itself growing in importance.

It is not difficult to get alcohol practically free from all impurities, including water as one, but to free it from the last one thousandth part of water is very difficult indeed,—so difficult, that traces of this ultimate fraction of water have so far always been retained. Hence in considering it as absolute alcohol it can only be regarded as being freer from all other impurities than from water, and as being more or less free from water. No alcohol should be called absolute, however, that contains less than 99.4 p.c. by the best determinations. When carefully freed from all impurities except water, specific gravity becomes a very accurate indication of strength, and it has always been relied upon as the decisive test. For many years each careful observer reduced the specific gravity little by little to those upon which the tables of the present day are based, by using new appliances which the progress of knowledge supplied to his hands, and the object of this note is to show that improvement in these appliances is not yet at an end.

Some writer has well said, in substance, that in the advancement of knowledge the position of each day should be occupied as the nomadic Arabs occupy their tents, ready at any moment to pick up and move on.

In the manufacture of absolute alcohol in considerable quantities by the very slow, cold percolations through large and successive

portions of quicklime, the writer has not unfrequently seen it come from the rectifying still of a specific gravity below that of the lowest of the tables and of the best and most recent authorities; and the entire product of the process for the past two or three years has been of such strength that all the hydrometers tried have sunk below the reading scale. In one instance a Government Inspector pronounced the alcohol to be 102 p.c. strong ! ! Another Inspector made it 99.8 p. c., but he could not possibly have done this with his official instruments, because his hydrometer would sink below the reading scale, even when the alcohol had been exposed to the air by several trials. These observations were made upon alcohol that, having been managed with a considerable air contact, could not be completely anhydrous, since very strong alcohol takes moisture from the air very rapidly indeed, and changes proportionately in specific gravity. It was therefore concluded that the tables were all too high for the present time, and that the subject merited a reinvestigation. This was undertaken, and has been carried out with much care and pains through the past three months, with the results now to be offered.

Preliminary to the investigation the authorities on the subject were carefully examined. They were found to be very numerous, very discordant, and in an almost hopeless state of confusion. Much of the discord and confusion arises from the use of different standards of volume in taking the specific gravities; from failure to state what standard was used, and from making the observations at many different temperatures.

In "The Constants of Nature," compiled by Frank Wigglesworth Clarke, S.B., and published by the Smithsonian Institution, no less than thirty-three specific gravities from twenty authorities are given, with the statement that the compiler considered it best to give only the more important determinations. Hardly any two of these are in fair accord, the same authority often giving several different determinations.

Three standards of volume, at least, appear to be in common use, and as they are rarely stated they have to be either deduced or inferred.

The general statement of good authorities,—Watts' Chemical Dictionary, for example,—is, that in Great Britain the standard volume for unity is a volume of pure water at 60° F.=15.6° C., while in France and Continental Europe generally the volume of water at 4° C.=39.2° F. is taken for the unity standard.

It is probable from some of the figures given that some of the authorities give true specific gravities,—that is, where equal volumes of the standard water and the alcohol are weighed at the same temperature and corrections applied for difference in density between the substance and the weights used. But it is equally probable that most of them give apparent specific gravities; that is, where the standard is at one temperature, and the equal volume of the alcohol is weighed at another temperature, without corrections either for expansion of the vessel used, or for density of weights or barometric pressure.

These apparent specific gravities are far the most useful, and therefore, most important, and if a common standard was adopted they would be all sufficient, because easily and quickly taken, and easily compared with sufficient accuracy.

In true specific gravities,—that is, where the standard and the liquid of the same volume are weighed at the same temperature,—the chief correction to be applied is for difference in density between the liquid and the weights. This error is in the fifth decimal place, and is only important when a very high degree of scientific accuracy is aimed at. The error is plus and has to be subtracted, the observed weight being that much greater than it would be in a vacuum. It, therefore, makes the observed s.g. too high.

In apparent specific gravities, that is, where the liquid is weighed at other temperatures than that of the standard, another error comes in, and that a much greater one, namely, the expansion of the vessel in which the weighing is done. A glass vessel holding 1000. grammes of water at its maximum density, or 4° C., will so expand at any higher temperature as to hold ·025 gramme more of water for each 1° C. This is also a plus error, making the observed weighing greater than it should be, but as it requires 20° C. to make it reach the third decimal place, in the s.g. of alcohols, it is not of great practical importance in every-day uses.

In specific gravity tables for daily use in the arts, neither of these corrections should be applied, because it is neither convenient nor easy to apply them in common practice to the liquids which are to be compared with the tables. Any one can take apparent specific gravities quickly and with a fair degree of accuracy, and in referring these to tables there should be an accord between the observations and the tables. Besides, when these corrections are disregarded the errors are still within the sphere of error of the tables in common use. The closest attainable specific gravity for absolute

alcohol being reached, and being stated both in apparent and true terms to the fifth decimal place, is all that is needed to correct the tables at any desired point, leaving the more general correction to be made as better usage may demand it.

The very numerous and very discordant authorities on the strength of absolute alcohol have been frequently noticed and criticised of late years, and nowhere better than by the eminent Russian authority Mendelejeff, and the accuracy, care and labor of this author have given the example which the writer has tried to imitate in the following investigations.

D. Mendelejeff published in St. Petersburg, in 1865, a quarto volume of 119 pages, exclusively on the subject of absolute alcohol. A copious abstract of this paper was published in the "Zeitschrift für Chimie,"—Beilstein and Fittig, 1865, under the heading "Ueber die Verbindung des Weingeistes mit Wasser." From this abstract the writer's assistant, Miss Marie O. Glover, S. B., made notes and translations, of which great use has been made in this paper. Mendelejeff is not only the latest but by far the best authority which has been found on the subject. He reached a true, corrected s.g. of ·79367 at 15° C., compared with water at 4° C., which is practically in accord with Fownes and Drinkwater, and nothing could be usefully added to his admirable researches, except that the improved mechanical appliances of the twenty years since he wrote have probably brought it within the reach of any one going over the subject at the present day to obtain an alcohol that is more nearly anhydrous.

The very thorough investigations of Gilpin for the British Government from 1788 to 1794, and published complete in the Philosophical Transactions of the latter year, brought the strength of alcohol to a s.g. about ·7939 at 15.6° C.=60° F. compared with water at 4°.

Fownes' Philosophical Transactions, 1847, and Drinkwater,* each went over the subject some fifty years later, and brought the s.g. down to ·7938 and ·79381 at 15.6° C.=60° F., compared with water at the same temperature.

Kopp, in his elaborate researches on the expansion of liquids by heat, in 1855 and 1856, embraced alcohol among the liquids, and he is often quoted as authority for the s. g. of absolute alcohol. But the best results given by him are considerably above those of earlier

* Memoirs of The Chemical Society, 1848, vol. 3, p. 447.

and later observers, and it is doubtful whether he supposed that he obtained anhydrous alcohol, or sought for it especially, since it was not demanded by the line of his special research.

Next came Mendelejeff, with the paper previously referred to, and these were the chief among the many original observers. In regard to the work of Gay-Lussac and Tralles, Mendelejeff remarks, in substance, that their numerous grave errors place them outside the pale of rational criticism. And to these the commonly accepted German authority, Stampfer, may well be added.

It is particularly unfortunate that these three authorities should, by the construction of their elaborate tables upon erroneous bases, have misled the world for so many years upon this enormous alcohol interest.

Tralles, in 1811—Gilbert's Annalen xxxviii, 386,*—adopting Gilpin's researches as far as they went, deduced a s. g. for anhydrous alcohol of ·7939 at 15° C.=59° F. compared with water at 4°. This was nearly correct from his data. But he does not use this, and does use instead, as the basis of all his work, an erroneous equivalent to it. He states that this s.g. is equivalent to ·7946 at 15.6° C.=60° F. compared with water at 15.6° C.=60° F., and upon this statement all his tables, excepting one, are based. The one exception, namely, that based on a temperature of 15° C.=59° F. compared with water at 4° C., is not used except as a basis for his erroneous deduction. Instead of ·7946 at 15.6° C. compared with water at 15.6° C. being the equivalent to ·7939 at 15° C. compared with water at 4° C. the difference is only about ·00021, making the s.g. he should have deduced from his data about ·79411.

Gay-Lussac, in 1824, practically reaches the same error with Tralles, which he appears to adopt from Rudberg, by giving ·7947 as the s. g. of anhydrous alcohol at 15° C.=59° F. compared with water at 15° C.=59° F., supposing this to be the maximum density of water,† although it was well known in his day, and long before it, that the maximum density of water was 4° C.=39.2° F. All his voluminous tables are pervaded by these errors.

Stampfer, who appears to be a commonly accepted German authority, whose table is given in Hager's Untersuchungen, and in this country in Hoffmann and Power's Examination of Medicinal Chemicals, at p. 207, gives the s.g. of absolute alcohol, at ·7951 at

* Quoted from Watts' Dictionary of Chemistry, p. 83.

† Quoted from Muspratt's Chemistry, p. 123.

15° C.=59° F., compared with water at the same temperature. This, of course, is still more inaccurate than either Tralles or Gay-Lussac.

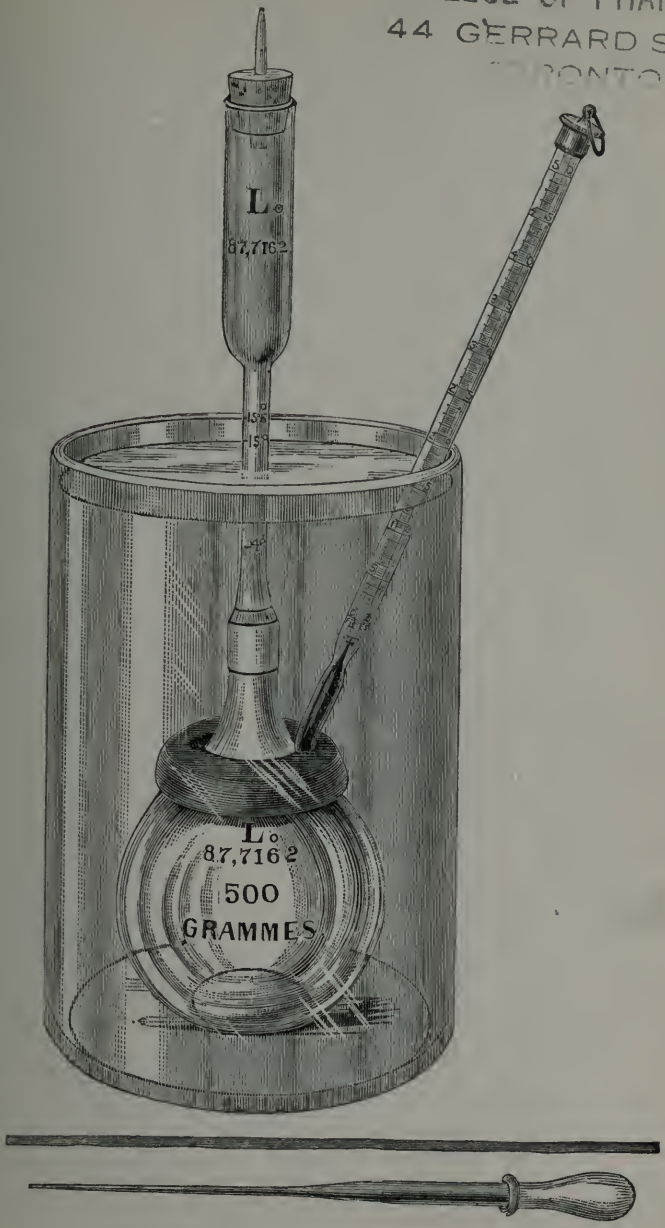
Tralles' tables are accepted and established by law in both Great Britain and this country, and although the error amounts to just about a quarter of one per cent. between Fownes, Drinkwater, and Mendelejeff, who are practically in accord, and Tralles and Gay-Lussac, who are also practically in accord, this difference is accountable for the loss of millions of revenue. The British Government adopted the tables, and re-adopted them before the extent of the errors was fully recognized, and have simply adhered to them rather than suffer the inconvenience of changing them. But in this country they were adopted long after the better determinations were published, and, since it is now to be hoped that the tax on spirit here will soon be abandoned, it would be unwise to change.

In the writer's investigations he accepted the statements of Mendelejeff and others, that caustic lime was the best agent to use for dehydration, and that this agent leaves the alcohol quite unchanged in elementary composition. The improvements he has been able to make upon the methods of previous investigations have been chiefly: First, in starting with alcohol of much lower s.g. than any before used, and in having this in great abundance for the desired modifications and repetitions of the process. Second, in having a mechanical shaker, driven by steam power, wherein two bottles of the capacity of four litres, or one gallon each, could be shaken at the rate of 240 vibrations a minute for any desired length of time, thus getting a better agitation and a more effective contact with the lime than has been previously practicable. Third, in filtering out all suspended lime before distillation, in an apparatus well supplied with desicated air. Fourth, in distilling in a partial vacuum equal to 23 inches of mercury, thus reducing the boiling point to about 51° C.=124° F., and freeing the distillate from dissolved air and other vapors, and from any traces of ethers or liquids of low boiling points. Fifth, by distilling under this partial vacuum directly into the s.g. flasks. Sixth, by the use of special specific-gravity flasks of very large size, so as to reduce all errors of filling and weighing.

The thermometers used were graduated to ·2° C., and were read to less than ·1°, and were corrected by comparison with a standard instrument just before the observations were commenced, and as the investigation continued over nearly three months, they were twice re-compared during that time.

The balance used for the final determinations was examined and put in good order by Becker & Sons, for the weighings, and was sensitive to five milligrammes when loaded to 500 grammes with the flask and contents ; and the weights were a new and accurate set obtained for the purpose.

The rougher determinations were made in a s.g. flask of 500 grammes capacity, illustrated at page 353 of this series of pamphlets; but the finer determinations were made with two special flasks of better construction. One of these, chiefly used as a check upon the other, is of 100 grammes capacity, and was used on a fine balance, sensitive to ·0001 gramme when loaded, and with a different and very fine set of weights. The other flask has a capacity of 500 grammes, and is illustrated in the accompanying cut. In construction, it is simply an enormous thermometer of short range. The flask has a very carefully and accurately ground stopper of barometer tube, the tubular portion being about eight centimetres or 3.2 inches long, and about three millimetres or one-eighth inch bore. The upper prolongation of this is a very much larger tube of about the same length, and of nearly two centimetres or three-quarter inch internal diameter, to receive the expanding liquid as the apparatus is warmed up to the temperature of the balance case before the weighings. The ground joint is lubricated and made entirely tight by a very small portion of pure soft paraffin, which does not alter the tare perceptibly. The calculations of s.g. are very much simplified, and liabilities to errors reduced by having the capacity marks adjusted to 500 grammes. There are three graduations on the tube, all for 500 grammes of recently distilled and recently boiled pure water. Filled to the lower mark, the flask holds 500 grammes of the water at its maximum density of 4° C.=39 2° F. To the second mark it holds the same quantity, but at 15° C.=59° F., and to the upper mark, the same weight, but at 15.6° C.=60° F. These adjustments were all made in a bath continuously and vigorously stirred, and kept at the exact temperature by continuous additions of cold or warm water until the column in the tube ceased to rise or fall. In practice it was found that when the bath and the column had remained constant for about ten minutes, no change occurred by prolonging the time. A change of ·1° C. in the temperature of the bath was hardly perceptible when the flask was charged with water to the lower, or 4° mark, because water changes very little in volume when within a degree of its maximum density, but at both the upper marks a tenth of



SPECIFIC GRAVITY APPARATUS
FOR ACCURATE DETERMINATIONS.

a degree change in the bath was easily seen, and reached its maximum in about ten minutes. When charged with alcohol, however, a tenth of a degree in the temperature of the bath gave a difference of more than a centimetre or $\frac{3}{8}$ inch in the height of the column, and the whole column was not long enough for a single degree. Thus changes in the alcohol could be easily read to the one hundredth of a degree of temperature of the bath, and thus the errors of filling, and of form and size of meniscus are reduced far within the error of any balance in the weighings. This adjustment by corrected thermometer in the bath, and active stirring of the water, was not only used in adjusting the capacity marks with the standard distilled water, but also with the adjustment of the alcohol for each observation, and so well did it answer, that great confidence is felt in the results attained by it. A collar of lead is shown which keeps the flask from floating in the bath.

It is very convenient to have that part of the tube in which the adjustments are made graduated in millimeters, so as to see better when the liquid ceases to rise or fall before the final adjustment to the mark.

For the adjustment of the alcohol to the marks—which, of course, is done while the flask is in the bath—a long and very fine pipette with a rubber tip is shown. Properly constructed and skilfully managed, this, after a little practice, will be sufficient to make the adjustment to the marks with great accuracy, but if a very little liquid is to be taken out, a narrow strip of bibulous paper is better. For working as rapidly as is practicable two baths are needed : one at the capacity temperature for adjustment of volume, and the other at the temperature of the balance case to warm or cool the flask before weighing.

As a counterbalance or tare for the s.g. flask, the very clever device of Mr. Drinkwater was used, but was improved by sealing up the counterpoising flask at the time of adjustment. A flask of the same glass and the same capacity was so constructed that the closed stopper could be sealed in when made to accurately counterpoise the s.g. flask on a fine balance, the counterpoising being done to within half a milligramme. The stopper furnished at top with a ring and a hook of platinum wire, was then sealed in at the time of adjustment so that the contained air can never change either in volume or humidity, or weight, with any barometric or other changes. This is hung from the hook over the balance pan and leaves the pan clear for weights. By the use of such a counterpoise the error for

buoyancy of air, or difference in density between the brass weights and the s.g. flask and contents is very much reduced, so that being removed to the fifth decimal place, and the weighing being only to the fifth, the correction may be disregarded and omitted.

With such an arrangement and a little practice, six or seven very good determinations may be made in a day, at any of the three common standard temperatnres to which the flask is adapted.

The common standard for alcohol in this country, obtained from the common usage in Great Britain, is to weigh it at 15.6° C.=60° F., compared with water at this same temperature as the standard volume for unity or 1·0000, and this is convenient, not only because the usage is so well established, but also because it is a true specific gravity, in that it is at once fairly accurate without correction for expansion of glass, as when the standard volume for unity is at a different temperature from the weighing. Nevertheless, water at 4° C. is a much better unity standard, and is rapidly becoming the universal one.

To economize time and space in what is to follow, whenever a s.g. is given without giving the temperature or standard, it is to be understood as taken at 15.6° C.=60° F. compared with water at the same temperature, as unity. It is rather a curious coincidence which could hardly have escaped the notice of Tralles, had he taken his specific gravities himself, that the apparent s.g. of an alcohol of ·79390 at 15° C.=59° F., compared with water at 4° C.=39.2° F. is only about ·00002 less than the s.g. of the same alcohol weighed at 15.6° C.=60° F., compared with water at 15.6° C.= 60 F. as unity, this latter being ·79392.

The alcohol for the following determinations was prepared as follows :

Lumps of good caustic lime were ground to a coarse and fine powder, re-calcined at a bright red heat, and then, cooled in a close vessel, it was kept in bottles ready for the repeated dehydrations. About a half kilogramme or 1.1 pounds of this lime was put into each of two bottles of the capacity of 4 litres or one gallon, and upon it was poured about 2 litres or half a gallon of alcohol of a s.g. of ·7939. These were well corked, put into the shaking machine and shaken at the rate of 240 vibrations per minute until the contents became warm, or for about 15 minutes—then allowed to cool, and then shaken again until the aggregate time in one day amounted to about two hours. This was repeated on the second day and on the third, and after settling over night the milk-like alcohol was drawn

directly from the bottles without air contact into the distilling apparatus previously filled with dry air, by means of a Sprengel water pump.

The distilling apparatus consisted of a globular wide-necked flask of about 5 litres capacity, in a water bath with very little water. This flask was furnished with a large rubber stopper with three tubes —one for a charging tube that passed down to the bottom, and was controlled outside by a rubber tube and pinch-cock; —another for thermometer, and a third large tube leading the vapor to the condenser. The condenser was a tube of block tin passing through a long wooden trough capable of holding a plentiful supply of broken ice. The end of the condenser was connected by rubber tubing with one tube of a tapering rubber stopper of two tubes— the stopper of a size to fit the s. g. flasks. The second tube of this stopper was connected with the water pump by rubber and glass tubing. The flasks having been well rinsed with absolute alcohol, and the large one connected by the ingress tube with a double air-drying apparatus of sulphuric acid and chloride of calcium, a current of dried air was drawn through the whole apparatus by the pump during an hour or two. Then the ingress tube was connected with the alcohol bottles, one after the other, and the milky alcohol from the shaker was drawn in by the pump, free from any but the very fine particles of lime which refused to settle out with the coarser ones. When charged and properly closed, and the mercurial gauge of the pump showing a partial vacuum of 15 to 23 inches, the water of the bath was warmed up until the liquid boiled, —explosive boiling being prevented by platinum scraps and pieces of tobacco pipe-stem. An apparent boiling always preceded the true boiling from the very commencement of the warming, and was always quite active, thus freeing the alcohol from air, ethers, etc.; and during this bubbling the condenser was not cooled with ice, so that the pump was allowed to take off all these vapors before the true boiling point was reached. This true boiling point varied between 49° and 55° C. according to the vacuum. The first distillate was received in a 100 c.c. flask until this was filled. Then the two rubber tubes connected with the stopper were closed with pinch-cocks, the filled flask taken off, and replaced by one of the s. g. flasks. The tube leading to the pump was then opened, and the flask exhausted until the pump gauge had again reached 20 to 23 inches. Then the tube from the condenser to the flask was opened. The boiling and condensation having continued during this changing of receiving

flasks, a considerable quantity of condensed liquid flows at once into the newly placed flask, and then the distillation proceeds until another change is required.

In this way the s.g. flasks and others are filled until about 5 or 6 fractions are obtained at each distillation, the process being stopped while there is yet 100 c.c. or so in the distilling flask. This residue is thrown away, and the flask well rinsed out with the absolute alcohol and dried by a current of dried air as before, when it is ready for a new distillation. No lime, nor any other sensible impurity was ever found in any of the distillates, and they all, with the possible exceptions of the first two, consisted only of the alcohol and the traces of water still held. All the distillations were managed in this same way from first to last.

By the first distillation the s.g. was only reduced by about a unit in the fourth decimal place. That is, the alcohol was about ·79394 at the start, and was ·79383 at the end, and the different fractions differed materially. The result not being as low as was occasionally seen on the large scale of manufacture with less precaution, the cause of this was to be sought for. On several occasions during the years 1882 and 1883 large quantities had been seen as low as ·79364, ·79369, ·79375, etc.

The only discoverable difference was that on the large scale the liquid distilled was comparatively free from suspended lime, whilst in this distillation it was almost of the appearance of milk from suspended particles of lime.

From this circumstance a conclusion was reached, upon general chemical principles, that there must be a point at which the affinities of the alcohol and the lime for the water were balanced, and that this balance was constant only for a constant temperature. That when the two were left together, each having its share of the water for the lower temperature, and the temperature was then raised, a dissociation occurred, the alcohol taking back from the lime some of the water it had given up at the lower temperature, forming a new balance for the new temperature.

The same alcohol, with a sufficient addition from the original supply to make up the losses, was again subjected to the same treatment as before, only that after the shaking it was allowed 48 hours or more to settle. But, being as milky-looking as before, it was filtered by aspiration with the pump through a large chloride of calcium jar filled with the caustic lime resting on a plug of glass wool. The filtrate was returned without contact with undried air

until it came through very nearly clear, and was then drawn into the distilling flask until the charge was obtained ; the filtration requiring about a week by reason of the nearly impervious stratum of very fine lime which formed in the filter.

This time the distillate came off at ·79349 and ·79350, and when the fractions, excepting the first and last, were mixed together the s. g. was ·79350. This distillation left an oily-looking stain upon the distilling flask, which, with other circumstances, led to the conclusion that some impurity in the lime had been washed out by the alcohol, and that thus the distillate might be rendered less pure and clean than it should be.

The total distillate was therefore discarded, and a fresh supply taken having a s. g. at the start of ·79387, and this was put through the same process, only that it several times nearly ceased to pass through the lime filter, and it became necessary as often to uncover the lime to break up the impervious crust, and thus expose the alcohol and the lime to the ordinary air of the room in damp weather. The distillation from this charge was, as anticipated, of high s.g., namely, ·79365, or not much lower than at the start, but the alcohol was clean and good.

The same alcohol, with a portion from the original supply to make up losses, was put through the process, but the shaking was much diminished in time, so as to have less finely divided lime to obstruct the filtration, and less lime was used. Another, and very much larger lime percolator was set up and charged with ground lime from which all the very fine particles had been sifted out. This percolator was of the capacity of about 5 litres, and held about 2 to 2.5 kilogrammes of the lime, and was fitted with an air-tight cover in which was a hole fitted with a rubber stopper with two tubes. Two 5 litre bottles were fitted with good stoppers, through which passed two tubes, one to the bottom of the bottle and the other just through the stopper. The outer end of each tube was fitted with a short piece of rubber tubing and a pinch-cock. Both bottles having been filled with desicated air, the long tube of one was connected to the lower end of the lime percolator in such a way as to be controlled by a pinch-cock, and so that the rate of dropping from the percolator could be seen and controlled. Then the milky alcohol from the shaker was drawn over from the bottle onto the lime percolator by a syphon controlable by a pinch-cock, and the air which entered the bottle as the alcohol ran off was supplied from the desicator. The alcohol was passed through the

percolator at the rate of about a drop a second, and was supplied on top at a similar rate; so that about twenty-four hours was required to pass a charge through the lime. When the bottle at the top of the percolator was empty the one below it was two-thirds filled, and the lime was full of the alcohol, with a thin stratum above it. The pinch-cocks were then closed, the full bottle placed at the top of the percolator, and the empty one with dried air was put in its place below, and the apparatus started as at first. In this way the alcohol was passed through the lime twice with a much diminished exposure to undried air. The charge was then aspirated into the clean, dry distilling apparatus by means of the pump, and distilled in fractions as before. The result was, that it all, excepting two small fractions, one at each end which were not weighed, came over at ·79349 to ·79353.

This alcohol, without the farther addition of lime, and with the least practicable exposure to air, was passed through the lime percolator eight times, and then distilled. It then gave a s.g. of ·79350. Weighed at 15° C. and compared with water at 4° C. as unity, the apparent s.g. was ·79348 This, corrected for expansion of glass, gives a true s.g. of ·7932618.

A new portion of lime was then slaked with the smallest quantity of water that would reduce it to a fine dry powder. This powder was then calcined at a red heat for about seven hours and, while still warm, 100 grammes of it was put into each of two bottles, carefully supplied with dried air. Onto this lime about 2 litres of the alcohol of the last distillation was drawn through the lime percolator. The bottles were then put into the shaker and were shaken three times, at intervals of an hour or two, for about ten minutes each time. They were then allowed to settle for twenty-four hours, but still remained milky. The alcohol, as free as possible from the settled lime, was then passed four times through the same lime percolator as before, coming off entirely clear and bright after the second time. It was then aspirated into the distilling flask and distilled as before. The s.g. was at 4° C. compared with water at 4° C. ·80256. At 15.6° C. compared with water at 15.6° C. it was ·79351.

This terminated the series of distillations, because it was concluded that the best results by the use of lime and the described management had been reached, and not because the alcohol had been entirely dehydrated.

That it was not entirely dehydrated was probable, from several

considerations. First, both lime and alcohol form definite combinations with water, and at very low degrees of hydration it is highly probable, at least, that each will take water from the other until a balance of affinities be reached, so that both the lime and the alcohol form complex molecules of two, three or more molecules of lime or alcohol to one of water, constant only when together, under constant conditions of temperature and pressure.

Many of the authorities on absolute alcohol state that in the distillation of the alcohol after dehydration, only the middle portions of the distillate are anhydrous. This statement is difficult to comprehend. It is impossible to understand how, in the distillation of alcohol which contains any water at all, the first and last portions should come over hydrated and the middle portion anhydrous. These distillations only appear to show this, while the truth must be that the middle portions are only a little less hydrated than the two end portions. No completely anhydrous alcohol will be reached until the distillate is of the same s.g. from beginning to end. The writer's experience has shown that the lower the s.g. the more uniform was the distillate throughout, but he never reached a point where, if carefully weighed in the large bottle, there was not a slight difference between the ends and the middle of the large distillations of four litres at a time, requiring an entire day for the process. In his best results the difference was pushed back to the fifth decimal place, but it was always perceptible.

Again, it was not possible to manage the whole prolonged process and manipulations without some slight admissions of undried, or only partially dried air, and as the lower hydrations were reached it became very plain that so very strong was their affinity for moisture that very trifling admissions of undried air through a joint that would leak only a few small bubbles into the apparatus before discovery, would raise the s.g. perceptibly. Although such admissions were reduced to a minimum during the later distillations they were not altogether prevented, and their reduction was effected after the lime percolator had been so long used as to need a renewal of the lime. It seems quite certain, therefore, that undried air has a very important influence, and that it was not wholly excluded in any of the distillations, and also that toward the end the effectiveness of the lime percolator was diminished.

From all these circumstances it is safely concluded that anhydrous alcohol was not reached; and that if two or three weeks more could have been spared to the work, with a renewal of the

lime, and the lime better calcined, slightly lower results might have been reached even by the use of lime. Furthermore, the weather had become warm, and the air loaded with moisture, a condition recognized for many years past, in actual experience on the large scale, as being very unfavorable to the management of the process for absolute alcohol. Clear, cold weather, with a high barometer and low dew point, often makes a favorable difference of one or two-tenths of a per cent. in the result of a large distillation, even before the loss of strength inevitable in bottling the distillate.

The alcohol which resulted from these distillations was critically examined, and seemed to have all the sensible and chemical properties of pure and unchanged alcohol, except that it did not entirely resist the reaction of nitrate of silver. By prolonged contact even in diffused daylight the nitrate was very slowly and continuously reduced, so that in three or four days a scanty black precipitate was visible, and this seemed to increase slowly as long as it was under observation. It is possible that the contact with the rubber tubing and stoppers in the distillation may have been the cause of this very slight reaction, but in every case it affected the tint of the alcohol within 8 or 10 hours. It seems almost certain that permanganate of potassium decomposes pure alcohol more rapidly as the strength increases beyond 97 or 98 p.c. and it is possible that nitrate of silver does the same.

The distillation in 23 inches of a vacuum insured the absence of ethers, etc., of low boiling point, which might have been accidentally produced, and the most cultivated senses of professional experts in wine and spirits failed to detect any of the substances of higher boiling points. The only test not applied to it was that of combustion, and this was not resorted to, because several observers in the past have verified their results by repeated combustions of their alcohol, when it is now known that such alcohol must have contained water. To make such combustions that would be entirely trustworthy is very difficult indeed, and the writer would be quite incompetent to such work where such extremely accurate weighings are required, with such a difficult substance, containing so very small a proportion of water only.

Nine distillations were made, of which the principal ones only are given, and over one hundred and twenty weighings, and many of them were very successful.

Taking the 15.6° C. standard for unity, and weighing at this same temperature, and without other correction for buoyancy of air than

that by the use of a counterposing flask, two specific gravities of ·79349 were obtained, three of ·79350 and three of ·79351. The mean of these eight successful weighings is so nearly ·79350 that this number is accepted as the present specific gravity. Over 20 weighings were obtained below ·79367. Alcohol of a s.g. of ·79350 at 15.6° C. gave at 4° C. compared with water at 4° C. as unity, a s.g. by careful observation of ·802566. At 15° C. compared with water at 4° C. the apparent s.g. was ·79348. This corrected for expansion of glass, gave ·79326. At 15.6° C., compared with water at 4° C., the apparent s.g. was ·79301. This corrected for expansion gave ·79279. At 25° C. compared with water at 4° C. the apparent and corrected specific gravities were ·78557 and ·78496; and at 25° C. compared with water at 15·6° C. as unity the apparent and corrected specific gravities were ·78591 and ·78573.

Similar lines of weighings, with the exception of that at 15° C. were then made with combinations of this alcohol and recently boiled distilled water. The first with 99 p.c. by weight and 1 p.c. of water. Then 98 p.c. and 2 p.c. water; then 96 p.c., and then at intervals of 4 p.c. down to and including 40 p.c. alcohol and 60 p.c. water, and a table is submitted below of these actual weighings. The column of 15° C. compared with water at 4° C., has only four weighings, the remaining figures being the result of interpolations based upon the four weighings. All the specific gravities were weighed and are stated to the fifth decimal place, but the last decimal is only given for its effect upon the fourth, for it is not pretended that any ordinary balance or management will give correct figures for the fifth decimal place, even when a s. g. flask so large as 500 grammes is used.

The columns under the head of corrected specific gravities are corrected simply for expansion of the glass flask, and for the sake of those readers who may, like the writer, be no algebraists, and yet who may wish to make such corrections of apparent or observed specific gravities,—the arithmetical rule for correction will be given.

The cubic expansion or holding capacity of ordinary glass vessels is increased by heat at the rate of ·000025 of its capacity for each degree of the centigrade scale, and therefore a flask which holds 1000 grammes of water at 4° C. will hold 1000·025 grammes at 5° C., or (·025×11=) 1000·275 grammes at (4°+11°=) 15° C. Therefore, the expansion for 1° C. must be multiplied by the number of degrees of difference in temperature between that of

the standard volume for unity and that at which the weighing is made. This gives the total correction for unity. This must be multiplied by the number of units of weight which the flask may hold in order to get the total correction to be applied to any given flask. Suppose a flask which holds to the mark exactly 500 grammes of water at 4° C., be filled to the same mark with alcohol at 15° C., and is then found to contain 396·75 grammes of the alcohol. The correction for unity being ·000025 for each 1° C. and the difference in temperature between the standard of volume, namely, 4° C., and the volume at the weighing, namely, 15° C., being 11° C., the ·000025 multiplied by 11 gives ·000275, which is the total expansion per unit. Then as there are 396·75 units, this multiplied by the ·000275 gives ·10910625 as the total correction to be subtracted from the weight of the alcohol, because the flask by expansion through 11° C. of temperature holds ·109+ gramme more than it does at 4° C. Then by the common rule that a decimal fraction of 5 or more than 5 in one decimal place is to be carried as a unit to the next decimal place to the left, while one of less than 5 is to be dropped—this correction becomes practically,—not ·1091+, but ·11. This subtracted from 396·75 gives 396·64 as the weight of the volume of this alcohol, which is exactly equal to the volume of water at 4° C., and this is therefore the volume corrected for expansion of glass vessel. Now, if this series of figures be doubled, the capacity of the flask for water at 4° C. will be 1000 instead of 500. The alcohol will weigh (396·75×2=) 793·50, instead of 396·75, and this with the decimal point moved three places to the left will be the apparent specific gravity, because the figures 1000 are to be converted into unity of 1.000. Then the correction will be (11×2=) 22 instead of 11, and this correction applied to the 793·50 will reduce it to 793·28, and the moving of the decimal point three places as before, which is equivalent to dividing the number by 1000,—gives ·79328 as the true or corrected specific gravity of this alcohol at 15° C. compared with water at 4° C. It will now be seen that the figures 793·50, whether taken as 793·50 or ·79350, equally represent the accurate weight of alcohol to which the correction is to be applied. But these figures also represent the apparent specific gravity, and therefore, as a short cut across all this roundabout analysis of the operation, the following simple rule by which to correct for expansion of glass, is reached.

Multiply ·000025 by the number of degrees of difference be-

tween the temperature of the standard volume for unity and that at which the liquid is weighed, for the total correction for unity. Then multiply the apparent specific gravity by this total correction for unity, to obtain the total correction for the whole quantity. Subtract this from the apparent specific gravity, and the result will be the corrected specific gravity.

By this rule the corrected columns of the table are all obtained.

To all those thoroughly educated persons who can comprehend the algebraic formula $V'=V\ (1+K\ t)$, as this writer cannot, the above explanation, and much of the preceding detail, will seem prolix and useless. But so many are still to be found who are puzzled, confused and obstructed by algebraic formulas, who yet have the appetite for such work, and the capacity to do it with care and patience, that it has been thought worth while to go into much detail in this paper, which will be surplusage of the poorest kind to many readers.

When examined by the differences the results given in this table are only in fair practical accord, and are entirely wanting in the regularity of a mathematical table. The discords are mainly confined to the fifth decimal place. They often reach the fourth decimal place, but never the third, and these differences have a curious wave or curve which reaches its maximum between 64 and 68 p.c. When compared with the older table of the writer, republished farther on in this paper, this curve is quite marked, and very strongly suggests a curvature in the line of expansion of combinations of alcohol and water by heat, but the observations were not sufficiently accurate to be trustworthy at the decimal place of hundred thousandths, and make no pretension to such accuracy. They are given simply because they occur naturally in weighing to centigrammes with a 500 gramme s.g. flask, and to give a certain indication of the value of the figure in the preceding decimal place. The lower and more important specific gravities for absolute alcohol were all taken with the flask illustrated in this paper, and are believed to be quite trustworthy. But three of the dilutions were made with the 500 gramme flask illustrated at page 353 of a former number of these pamphlets, and are less accurate.

The entire subject well merits a more thorough and careful investigation, and if this paper should awaken an interest in it in some one with more ability and time than this writer has, it will serve a very good purpose indeed.

ALCOHOL TABLE.

Showing the specific gravities of combinations of alcohol and water, ascertained by actual observation at intervals of 4 per cent., on the new basis for absolute alcohol of s.g. ·79350, at 15.6° C.=60° F. compared with water at 15.6° C.=60° F. as unity; and showing both the apparent and corrected specific gravities at different temperatures by the two common standards for unity, namely, water at its maximum density of 4° C.=39.2° F. and at 15.6° C.=60° F. The table is sufficiently correct to be practically useful to the fourth decimal place.

Per cent. by Weight.	Compared with Water at 4° C.=39.2° F. as unity.							Compared with Water at 15.6° C.=60° F. as unity.		
	Weighed at—							Weighed at—		
	4° C.= 39.2° F.	15° C.=59° F.		15.6° C.=60° F.		25° C.=77° F.		15.6° C. =60° F.	25° C.=77° F.	
	True.	Apparent.	Corrected for expansion of glass.	Apparent.	Corrected for expansion of glass	Apparent.	Corrected for expansion of glass.	True.	Apparent.	Corrected for expansion of glass.
100	·80257	·79348	·79326	·79301	·79279	·78537	·78496	.79350	·78591	·78573
99	·80579	·79667	·79645	·79618	·79595	·78847	·78806	·79669	·78901	·78882
98	·80875	·79965	·79943	·79893	·79870	·79131	·79089	·79967	·79205	·79186
96	·81467	·80555	·80533	·80509	·80486	·79744	·79702	80558	·79801	·79782
92	·82593	·81680	·81658	·81631	·81607	·80865	·80823	·81684	·80915	·80896
88	·83649	·82751	·82728	·82699	·82675	.81929	·81886	·82755	·81982	·81963
84	84681	·83770	·83747	·83719	·83695	·82953	·82909	·83775	·83007	·82987
80	·85683	·84773	·84750	·84718	·84694	·83959	·83915	·84779	·84021	·84001
76	·86655	·85742	·85718	·85699	·85674	·84937	·84892	·85749	·84991	·84971
72	·87600	·86702	·86678	·86649	·86624	·85895	·85850	·86711	·85953	·85933
68	·88516	·87655	·87631	·87607	·87582	·86847	·86801	·87665	·86905	·86885
64	·89479	·88625	·88601	·88578	·88552	·87832	·87786	·88636	·87884	·87863
60	·90401	·89549	·89524	·89556	·89530	·88766	·88719	·89561	·88821	·88800
56	·91297	·90452	·90427	·90405	·90379	·89687	·89640	·90465	·89745	89724
52	·92177	·91349	91324	·91309	·91283	·90597	·90549	·91365	·90653	·90632
48	·93045	·92231	·92206	·92187	·92160	·91489	·91441	·92247	·91547	·91525
44	·93875	·93082	·93056	·93045	·93018	·92361	·92313	·93101	·92427	·92405
40	·94655	·93901	·93875	·93865	·93838	·93217	·93168	·93923	93275	·93253

In 1873 the writer contributed an article to The American Pharmaceutical Association entitled "Note on Buying Alcohol or Distilled Spirits," and this article will be found in the "Proceedings" of the Association, volume 21, p. 548. As it has been long out of print in a separate form, and where originally published is accessible to comparatively few persons, and as it has often been asked for on account of the convenient tables which it contains, it has been decided to republish it here. It has been especially inquired after since the last revision of the Pharmacopœia, because the substitution of parts by weight for arbitrary weights and measures makes it often necessary and always convenient to know the weight of given measures of alcohol of different strengths, and this is supplied by these tables. It is quite difficult to compare the strength of many of the alcoholic preparations of the old and the new Pharmacopœias without knowing the weight of the measures of alcohol, which are taken by measure in the old and by weight in the new. These tables give this information in a convenient form for reference, and the writer has in the past ten years had much testimony to the utility, not only of the tables, but also of his efforts to extend the custom of measuring and checking the quantities of alcohol by weight.

Since the publication of these tables in 1873, the writer has bought on an average about 360 barrels of alcohol a year, and for 2½ years has kept an accurate record of the quantity and strength of the contents of each barrel, and from this record, which now embraces 1,059 barrels, the shortages are shown to have diminished very much, and over-measure is now shown to be the rule.

The shortages had become so great in 1881 that it was decided to keep an accurate record of each purchase so as to watch them more closely. This record commences with October, 1881, and ends with April, 1884. It embraces 1,059 barrels of alcohol, bought in lots of about 10 barrels at a time, and amounts in the aggregate to 47,340 gallons, of the value of about $100,000. The s.g. varied between the limits of ·817 and ·822, but a very large proportion of it varied very slightly from ·819. The makers of the alcohol were:

J. S. Miller & Co. of.....Sterling, Ill.
G. T. Barker.....Peoria, Ill.
Monarch Distilling Co.....Peoria, Ill.
Fairbanks & Duenweg.....Terre Haute, Ind.
Atlas Distilling Co.....Des Moines, Ia.
Walsh & Kellogg,.....Cincinnati, O.

Woolner Brothers Distilling Co	Peoria, Ill.
Great Western Distilling Co	Peoria, Ill.
Hamburg Distilling Co	Pekin, Ill.
Atlantic Alcohol Distilling Co	Atlantic, Ia.
James Walsh & Co	Cincinnati, O.
Mound City Distilling Co	St. Louis, Mo.
Zell, Schwabacker & Co	Peoria, Ill.
International Distilling Co	Des Moines, Ia.

Every barrel was weighed and the measure calculated by the table, and occasionally when the temperature was nearly right, some were also measured. But the weighing always proved the more accurate, as it must of necessity be, and was far more rapid, more convenient, and was so much less wasteful, that the scale and pump were paid for by the saving of alcohol in the first year.

Every barrel was recorded with its shortage or over-measure with the following results :

The last quarter of 1881 embraced 114 barrels. Of these 44 were short measure to an aggregate of 8.078 gallons, while 70 were over-measure to an aggregate of 3.786 gallons. Balance short, 4.292 gallons.

In 1882 the record embraces 366 barrels, 250 of which were short in measure by an aggregate of 74.674 gallons, while 160 were over-measure by an aggregate of 42.192 gallons. Balance short, 32.482 gallons.

In 1883 the purchases were 396 barrels, 144 of which were short by an aggregate of 23.237 gallons, while 252 were over-measure by an aggregate of 90.105 gallons. Balance over, 66.868 gallons.

The first four months of this year embrace 183 barrels, 40 of which were short 14.130 gallons, while 143 were over-measure by 53.774 gallons. Balance over, 39.644 gallons.

Thus of the 1,059 barrels containing 47,340 gallons, bought within the 31 months, 478 were short by 120.119 gallons, while 581 were over by 189.857 gallons. Balance over-measure, 69.738 gallons.

This illustrates first, the extreme carelessness and inaccuracy with which this expensive commodity is treated by the U. S. gaugers, from whom there is no appeal by either manufacturer or purchaser; and next, that the prevalent practice of under-gauging has now been over-corrected. Before 1881 the rule was shortage. In 1881 and 1882 the shortage diminished, and in 1883 over-measure became the rule and still continues.

The number of barrels which actually contained within 1 gallon of the gauge on each barrel was, for the 114 barrels in 1881, only 7. For the 366 barrels in 1882, the number was also 7. For the 396 barrels of 1883, the number was 114, and for the 183 barrels of 1884, the number was 50.

The total variation from fairly correct measurement in this 1,059 barrels is over 300 gallons, and the balance of over-measure is nearly 70 gallons, and yet this substance is worth over two dollars a gallon.

No better testimony could be offered to the correctness of what was published in 1873, nor any better plea urged for the utility of weighing rather than gauging, and for the value of the tables. All who have applied the tables must have found it very much to their interest, as well as to their convenience, and to the economy of alcohol, and it is probable that the use of the tables may have had some influence in correcting the previous almost universal shortages.

With regard to the accuracy of the tables the foregoing researches have given much important information. It was stated in 1873, in the comments upon the tables, that the probable s.g. of anhydrous alcohol was about ·7934. This remains to be only a probability, or perhaps only a possibility still, since in the specific gravities which have come nearest to this it has been shown that the alcohol was not quite anhydrous. But it has also been shown that the lowest s.g. heretofore attained and the one on which the tables are based is certainly too high. Instead of ·7938 it should certainly not be higher than ·79350. But as this error involves a difference of about one-tenth of a per cent. at the base of the tables, and is a vanishing error, which disappears beyond four decimals before it reaches the 50 p. c. dilutions, and as still farther investigations by other hands and with better appliances may very soon reduce the proportion of water still lower, it seems better not to disturb the tables at present. Ever since the paper of Fownes was published his numbers have been gradually superceding the less correct figures of Tralles and Gay-Lussac in all ordinary channels, the national governments alone adhering to these errors. And a great many processes in the arts and manufactures being now based upon the better figures,—manufacturers buying by government standard, as they are forced to do, but working by more correct tables,—it would perhaps be unwise to disturb the older ones. The simple publication of the error, and of the probability that it is still not the final one,

but only the best results obtainable in the balance of the affinities for water between lime and alcohol, is sufficient for the present.

The description of the tables and the comments upon them, as originally published, and as now republished, guard them sufficiently against being accepted as scientifically accurate, yet they prove now, upon more thorough and more careful examination to be practically correct and trustworthy for all common uses within the limit of the error of their bases, and within the three decimal places to which they apply, and which is about the limit of the best common usage.

One of the most recent tables published is that of Dr. Otto Hehner, of London, and this table is of great importance in this country from having been adopted by the U. S. Pharmacopœia. It simply gives the s.g. of mixtures of alcohol and water in percentage by weight and by volume to the units of the fourth decimal place, the standard volume being water at 15.6° C.=60° F., and the alcohol being weighed at the same temperature, and the percentages being carried to the second decimal place. The Pharmacopœia does not state whether these tables are corrected for density of weights and of air, and the matter would be of no importance if the percentages were not carried beyond one decimal place. But as neither the first nor second decimal places are of any value with the ordinary means of taking specific gravities, nor within the scope of the Pharmacopœia, it does not matter whether the corrections are applied or not, though it makes the elaborateness of the table in this single direction merely surplusage. The writer's tables are, however, even more elaborate, but the elaborateness is not in a single direction, supplying much comprehensive information that can only be obtained from Hehner's table by complicated and troublesome calculations from data which have to be sought out from other sources not always of easy access, and much of this information is very useful in pharmacopœial practice. Indeed, the writer's table was constructed chiefly for pharmaceutical uses, and was communicated to The American Pharmaceutical Association as directly in the line of that interest, and as a continuation of a series of papers on the subject of economy in the management and uses of alcohol; and it was entirely at the disposal of the Pharmacopœia had the Committee seen fit to adopt it.

In comparing the figures of this table with those of Hehner's it seems very probable that both were compiled from the same source, namely, the table of Fownes. In percentage by weight, Hehner,

as given in the U. S. Pharmacopœia, is identical with Fownes for the units per cent, excepting in the range between 46 and 51 p.c., where there is a maximum difference at 50 p.c. of ·0002 in s.g. equal to ·09 p.c. in strength, and excepting in the single line for 91 p.c., where there is a difference of ·0001 in s.g. equal to ·04 in strength. Careful weighings by the writer at 50 and 91 p.c. give, when reduced to the basis of the table, namely, Fownes' ·7938,—the figures ·91845 for 50 p.c., and for 91 p.c. ·82016, the first being nearer to Fownes, and the second nearer to Hehner. On examining the table of Hehner by the differences, it appears to be constructed mathematically, and if the rate of expansion by heat at all points be accurately known for all mixtures of alcohol and water, and the contractions on mixing be equally known, this would be far the more accurate way. But neither rate seems to be very accurately established. The table accepts the authority of Drinkwater, and agrees with the British Excise Law for proof spirits, but does not agree with the U. S. law. All the fractions which come between the units of Fownes are supplied by calculation.

In the table as given in the Pharmacopœia, at page 419, there is a misprint of " 94.00 " instead of 95.00.

In the columns for percentage by volume Hehner's table is constructed by calculation. He multiplies the percentage by weight by the specific gravity, and divides the product by the s.g. of Fownes' absolute alcohol, and the quotient is the percentage by volume. In the writer's table the column for percentage by volume is adopted mainly from Tralles' erroneous results, because they are the almost universal standards adopted for use by hydrometers, and hydrometers are made to and by these tables ; and because their errors are within the actual scope of errors of hydrometers and hydrometer makers. Using the above rule for converting percentage by weight into percentage by volume, and taking Tralles' absolute alcohol,—namely, ·7946, instead of Fownes' ·7938,—for a divisor, gives the figures of the writer's table for percentage by volume, and hence the difference between this table and that of Hehner has the difference between ·7938 and ·7946, or ·0008 as a maximum difference, and this is a vanishing difference which only affects the fourth decimal in s.g., and the second decimal in percentage when at its maximum, and disappears altogether from the range of decimals used in either of these tables or any table before the weaker dilutions are reached. Hehner does not give the equivalents, in either s.g. or percentage, of the systems of gaug-

ing in use by either this or the British Government, and yet all alcohol must, by force of law, be bought and sold by these systems, —and never by either percentage or s.g. This table gives both these systems from official sources, and also the weights of corresponding measures of all strengths by all the methods of computing strength.

The best way of expressing the strength of any spirit is in percentage by weight, and far the best way of measuring quantities is by weight, and it may be confidently expected that buyers and consumers will sooner or later enforce this better usage as they have done with so many other liquids. The laws of Great Britain and this country have long been the principal obstacles in the way of this reform, and the complications of two different strengths for proof spirit,—of percentage under and over-proof,—of imperial gallons, wine gallons and proof gallons are so confusing and obstructive in contrast with the simplicity of percentage by weight for strength, and weighing the liquid for quantities, that there can be no doubt as to which system will ultimately prevail.

The writer's tables are printed here on one side of the leaf only, so that they may be cut out and pasted on boards if desired. Ten years' experience has shown that when thus mounted and the paper sized and varnished, they are very useful and last indefinitely even where large quantities of spirit are handled by them.

An accidental discovery recently made by the writer is of much importance to those who wish to buy the best alcohol they can get. Having for many years tried the products of many makers in search of the best quality and the highest strength for making ether, absolute alcohol and other products of alcohol, it was accidentally discovered that the article sold as alcohol was neither as good in quality nor as strong as the article which is made in such enormous quantities for the liquor dealers. He has many times tried the article sold as Cologne Spirit, at a much higher price, but has found it not uniform in cleanness nor in strength, and has each time given it up and gone back to alcohol of the best makers. It is now found, however, that there is an article which comes into this market in quantities of 200 to 300 barrels a day, branded simply as "Spirits" or "A. Spirits," and which is called by the liquor dealers by various names as French Spirits, Neutral Spirits, White Brandy, etc., and which is sometimes branded by the sellers here as "Cologne Spirit," which is just the article desired. It is made so "sweet" and clean and pure and free from odor, that by addition of the artificial essences

of brandies, wines, etc., now sold, it can be converted into liquors of all kinds and strengths, and it is manufactured of the highest possible strength to save in the expense of barrels and freight on the water. While alcohol is sold as "188 per cent.," this spirit is sold as "190," and in the lots of it already used it has been found to be between "190 and 191 per cent." by Government inspection. The s.g. is ·8155 to ·8147, and it, therefore, averages about 93 p.c.; while alcohol averages somewhat over ·819, and is, therefore, a little over 91 p.c. The cost of this spirit is about 5 to 7 cents per gallon more than alcohol, but as it averages 1.5 p.c. stronger than alcohol, and as each per cent. in strength is, at $2.25 per gallon for 92 p.c., worth (225÷92=) 2.44 + cents, the 1.5 p.c. additional strength is worth 3.66 cents, leaving about 2.33 cents per gallon as the cost of the additional purity or cleanness. Therefore, quality considered, it is the cheaper article at 6 cents per gallon advance on the price of the alcohol of the present time.

This spirit is understood to be the article used entirely by the large perfumery interest,—or at least by those in this interest who know its superiority over alcohol,—and also in other arts and manufactures, but those who use it seem to keep their knowledge of it to themselves, as among their trade secrets. It is understood that it is made by reducing alcohol to "proof strength" with water, and passing this diluted alcohol through charcoal. Then concentrating the spirit again as far as is possible, by means of the rectifying stills and columns now so largely used, and it is understood that the cost of this process is about 2 cents per "proof gallon" or four cents on the gallon of concentrated spirit. But it is not easy to see how it can cost as much as this when done on the enormous scale of these distilleries.

This spirit answers to all the tests of the Pharmacopœia, excepting the nitrate of silver test, and no ordinary spirit or alcohol accessible will stand that test as there applied. Each gallon of the spirit requires about 950 grains of water to reduce it to the officinal strength.

Ordinary alcohol, s.g. ·820, weighs, see table, 6 lbs. 13 oz. 130 grains to the gallon, or 273 lbs. for 40 gallons, and this is the "188 p.c." alcohol of the Government Inspector. The "Spirits" is "190 p.c." according to the same authority, and weighs 6 lbs. 12 ounces and 362 grains to the gallon, or 272 lbs. to the 40 gallons. Therefore when the stamps on the barrels indicate these strengths the weights of the contents should correspond if the measures be correct.

(Reprint of 1873.)

NOTE ON BUYING ALCOHOL OR DISTILLED SPIRITS.

WITH A TABLE AND WOODCUT ILLUSTRATION.

That the real interest of the buyer and the seller are the same in all bargains, is a truth long ago proven and illustrated in all social intercourse. Yet the reverse of the proposition is practised as the common basis of mercantile transactions, even in the present day of more accurate reasoning and more extended foresight.

This condition of antagonism of interest between buyer and seller must, however, be accepted, though under protest against the error as one which supports a world of evil upon its broad shoulders. From this error springs the necessity that, from the consumer all the way back to the producer, the buyer must guard his interest *against* the seller; and also the circumstance that the rules and customs of the producer in the sale of his products are not the safest nor the best for the consumer, whilst the interest of the producer is powerful, compact, and highly educated, in comparison with that of the consumer.

This is notably the case in regard to alcohol and all spirits, and because the producer has always represented the most active and compact interest, his counsels have always prevailed in the schemes which the governments of Great Britain and this country have adopted, for collecting revenue from spirits. But because the older government clings to, and the other adopts a plan for collecting the revenue from spirits, which plan is not up to the knowledge of the day, is no reason why the consumer should continue to accept it, without from time to time, as knowledge advances, applying the test for greater accuracy and greater utility; since not even government authority can permanently establish that which is inferior in truth or utility, against the progress of knowledge.

Pursuing the subject of economy in the use and management of alcohol, so often presented to this Association by the writer during past years, he now begs to offer some objections to the common methods of determining quantities in the market for spirits, and to suggest improvements, which, if practicable, may tend to harmonize the interest of the consumer and producer, and thus foster the true interests of trade. The suggestions are all based upon controlling quantity, by the simple and easy centesimal plan of Continental Europe. This centesimal or decimal method has, like the metrical system of weights and measures, met with a resistance from the governments of Great Britain and this country, which could hardly have been expected, and with regard to the metrical system, this resistance is only now giving way before that power of advancing knowledge which may be retarded and hindered but cannot be stopped.

Alcohol and water *combine* in all proportions. That is, as the union of the two substances is attended by the development of heat, and by contraction in volume, the result is a *combination* and

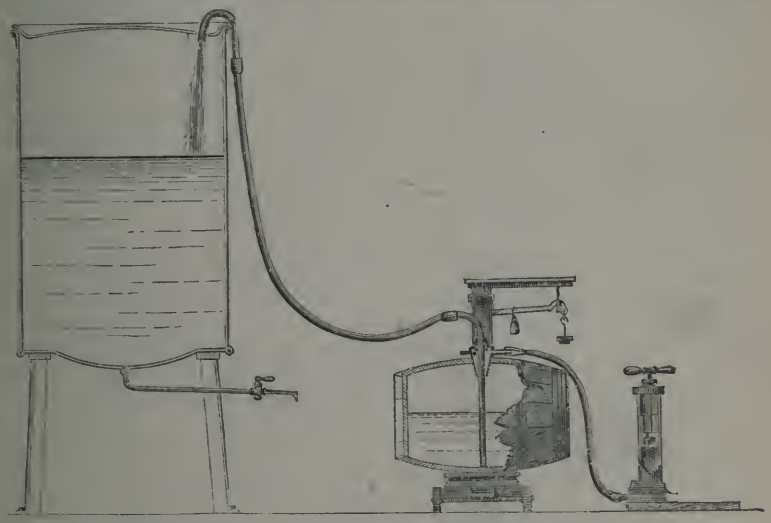
not a *mixture*. Any given volume of water expands slowly at an unequal rate, as it is either warmed or cooled from its point of maximum density (3.945° C.=39.101° F., Playfair and Joule), without change in weight. Alcohol also expands at an unequal rate, but it expands or contracts throughout the whole range of known temperatures. That is, it has no known point of maximum density. Its rate of expansion at ordinary temperatures is about five times that of water, and the inequalities or irregularities of its rate of expansion are different from those of water. Beside this, combinations of alcohol and water do not expand at the mean rate deducible from the rates of the two substances, but at a new rate peculiar to the combinations, or rather perhaps at a new rate peculiar to each combination of the two liquids. All combinations of alcohol and water are commonly called "spirit" or "spirits," and the alcohol of the combinations is the only element of value, and the only thing that is bought or sold, the water being a mere incumbrance that is bought and sold incidentally only. Hence every bargain is in reality for the sale and purchase of a definite quantity of absolute alcohol, and involves some plan of determining this quantity to a practical degree of accuracy; and, whatever plan may be used the result is commonly expressed in percentage, or by the number of hundredths of alcohol which the given combination of alcohol, water and impurities contains. Two quantities, therefore, have always to be determined to the mutual satisfaction of seller and buyer. First the quantity of the combination, and next the quantity or proportion of alcohol which the combination contains. The circumstances alluded to above render these determinations somewhat complicated and difficult to understand correctly, thus opening the way to abuses which pass unchallenged for years, and have a strong tendency to grow. So long as the stronger grades of alcohol were bought and sold at the low prices of 40 to 60 cents per gallon, shortages, the sum of which did not exceed 3 or 4 per cent., were not very important, and were suffered, because of the cost of reforming the plans, or through want of intelligence in buyers. But now that the same grades of alcohol cost nearly four times more, the shortages become proportionately important, and it is high time that buyers should so educate themselves as to be able to check and control their quantities if they choose to do so, and have that advantage of knowledge over ignorance, which legitimately and fairly belongs to him who knows his market.

The first determination of quantity, that is, of the quantity of the combination, or so-called mixture of alcohol and water, commonly known as "spirits" or "distilled spirits," or "high wines" or "alcohol," is made by capacity measure, and the result is stated in gallons. This measurement is generally made by gauging, and this gauging of casks and barrels is generally done by the straight gauge-rod and wantage-rod. Now, apart from the difficulties of temperature and the gauger's method of observing it, there is in this plan of measurement a good chance for many errors, which

should not be unknown at the present cost of alcohol. Casks and barrels are not uniform in shape, though the same rule is applied to all. The stave opposite to the bung-stave may be thinner than the other staves. The staves and heads may be either thin or thick, yet must be chamfered down very thin at the chimb, where the gauge-rod touches the angle between stave and head, and the wantage is calculated upon an ideal bilge which can only be realized by accident. Hence, although ganging may be well adapted to the measurement of liquids the value of which is not above 50 cents per gallon, it is not accurate enough for liquids like whisky, high wines, alcohol, etc., whose value is from 90 cents to $2 per gallon. In other liquids the value of which has increased within the past few years, involving closer dealings and smaller profits, capacity measure is rapidly giving way to weight, and olive oil, linseed oil, castor oil, etc., are now sold and bought by weight, though some are in the transition stage as yet, that is, bargained for by the gallon, yet the number of gallons ascertained by weight on the basis of so many pounds and ounces to the gallon. But even if the plan of gauging be susceptible of the accuracy for which it has general credit and acceptance, no such accuracy has been realized in the experience of the writer, who has for many years been a buyer of alcohol in the common market, and has always measured or weighed it as received. The aggregate result of this experience of many years is that, with occasional rare exceptions of over measure, a large proportion were either correct or less than half a gallon short (which latter was always accepted as correct). But a very considerable proportion of the barrels were from half a gallon to a gallon short, thus making a very constant average loss to the buyer, until a special bargain was made in regard to shortages. This special bargain of late years has been that where any barrel falls short more than half a gallon the whole shortage upon it is claimed and allowed. This bargain, of course, nets a loss to the buyer, but a loss which has fixed limits. Beside, any such bargain makes a buyer a troublesome customer to the seller, since the latter never knows when he is free from these claims for shortage. Of late years the writer has made all his remeasurements by weight, and the convenience and saving of time and saving of alcohol by this device have been so great, that it can be confidently recommended to all who desire to control or check their quantities. It is only necessary to take the specific gravity of the alcohol by an hydrometer, roll the barrel on to a scale, take its gross weight, empty it into the storage tank, and take the weight of the empty barrel for tare. This yields the net weight, which is easily turned into gallons as follows. The so-called U. S. legal standard gallon is 58,372.1757 grains at 39.83° F., which is equal within practical limits to 58,320 grains at 60° F. Suppose the specific gravity of the alcohol to be 0.817 at 60° F., then the process for accurately determining the weight of a gallon of it at 60° F. would be as follows: As 1.000 (= distilled water at 60° F.) is to 0.817 (= the spe-

cific gravity of the alcohol at 60° F.), so is 58,320 (= weight in grains of 1 gallon of distilled water at 60° F.), to 47,647.44 (= weight in grains of 1 gallon of the alcohol at 60° F.). This last number of grains is equal to 6 pounds, 12 ounces, and 397 grains, or practically 6 pounds and 13 ounces, and this being the weight of 1 gallon, it has only to be divided into the total weight of the contents of the barrel to get the number of gallons. The rule for practice deduced from the above process, is simply to multiply the weight of a gallon of water by the specific gravity of the spirit, when the product will be the weight of a gallon of the spirit. To render this plan easily practicable, the writer has calculated the weight of a gallon of spirit for each per cent., both by weight and by volume, and gives the results in a table herewith presented.

Some means of avoiding the loss of time and of alcohol in transferring it from the barrels to the storage tank, was for a long time much needed by the writer. This is of late very satisfactorily accomplished by condensing air on the top of the alcohol in the barrel, by means of a common air syringe, and thus forcing the liquid out through a pipe which leads into the tank. This simple device is a mere application of the principle of the old "amorce-syphon" of the French, and this application will be best understood by the accompanying woodcut, which has been prepared to illustrate it, the block



being offered herewith for the use of the Association, should it see fit to give this paper a place in its Proceedings.

A hollow, conical cast-iron bung, made with a screw-thread upon its exterior, such as is in common use to hold the pumps by which petroleum is transferred, is bored and tapped on top and at the side.

Into the upper hole is screwed an inch nipple, and into the side hole a three-eighth inch nipple. Through the upper nipple is passed a piece of three-fourths inch block-tin or tinned copper pipe, down to the lowest part of the bilge of the barrel, and the lower end of this pipe is deeply serrated. The upper end is bent at a right angle, and is slipped into an india-rubber tube which leads to the tank. Where this tube passes through the nipple the parts are made air tight, by passing through a short section of rubber tubing, which fits tightly upon the tube above, and is stretched over the nipple below. The smaller nipple at the side is connected with a similar nipple on the air syringe, by means of rubber tubing, when the arrangement is complete. If now the iron bung be screwed into the bung-hole of the weighed barrel of alcohol, and the tube be pushed down till it rests upon the stave opposite to the bung-hole, the device is ready for the operation. If the barrel be nearly full a very few strokes of the pump will so compress the air on the surface of the alcohol, as to start the stream out through the central pipe into the tank, and from four to six minutes is sufficient to empty a barrel, and this without the loss of any alcohol, except that which wets the inside of the tubing. When the last of the alcohol is forced into the pipe by the compressed air, the rush of expanding air which follows it, blows out every ounce of alcohol from both barrel and tubing into the tank. A common gas-fitter's air syringe answers well for this purpose, and a wooden bung can be made to answer very well.

The second determination of quantity to be made is the quantity or proportion of alcohol—absolute alcohol—which the given combination or mixture contains, and as the absolute alcohol is the real and only object of the buyer, this determination is very important, since the seller may wish to sell water at the price of alcohol if he can. At the present ruling rates for spirits in the market, each 1 per cent. or each hundredth part by weight of absolute alcohol is worth about 2 cents ; a little less for the weaker spirits, and a little more for those containing over 92 per cent., but about 2 cents as an average from about 95 per cent. downward. Hence errors of 1 per cent. in strength involve differences of 2 cents per gallon in value. Then as apparent strength varies with temperature to the extent of about 1 per cent. for each 3° C. or 5½° Fahr., on an average throughout the whole range of the combinations, but amounts to nearly 1 per cent. for each 1° C.=1.8° C. throughout the middle and stronger part of the range. Such differences of temperature are equal to about 2 cents per gallon, also, by the expansion produced.

The common method of determining strength or the proportion of absolute alcohol, is by an hydrometer of metal or glass with an arbitrary scale, which denotes, not simple percentage, but a compound or complicated percentage, expressed in degrees above or below proof. This plan is so complex, that for the most part its rules have to be empirically followed without being understood, and its expression of results is so difficult to translate into the simple decimal proportions of hundredth parts, that had it been intended

to confuse and mislead the millions of consumers for the advantage of the few thousands of experts who represent the producers, it could hardly have been better constructed. And from this comes the fact, that the masses of mankind who are interested in alcoholic liquids are so ignorant in regard to them; and therefore so careless and so easily deceived. Another circumstance which adds to the popular confusion in regard to the strength of alcoholic liquids, is the use of the term "percentage" and often "true percentage," to indicate two very widely different ratios of strength. The words "per centum," "by the hundred," in their meaning apply equally to computations by weight or by volume, but by general consent and common usage, the term per cent. when not qualified means per cent. by weight, that is, the number of pounds, ounces or grains in the hundred, or a decimal relation by weight only, unless the sense forbids this, as in cases of tale or count. The reason for its general acceptance as a relation by weight appears to be that this idea is far the most simple, and most easily understood, and must always be the basis of all accurate computations. In its application to alcoholic liquids, however, it generally, though not always, indicates volumes, that is 95 per cent. alcohol generally means a combination which contains 95 volumes of absolute alcohol in the 100 volumes of the combination. But as a given volume of absolute alcohol weighs less than eight-tenths of the same volume of water at the same temperature, this 95 per cent. by volume becomes about 92 per cent. by weight. Thus the expressions, though differing by about 3 per cent., are equally true for the same thing, whilst the lower is the best and most simple relation. The higher, however, suits the seller best, and is often spoken of as "the true percentage" without the qualification "by volume." Now as specific gravity must always be the basis of every method of determining strength, and as this is and must always be a simple relation by weight, the volume remaining constant, the sooner all other relations are rejected the better. Hence this determination of quantity, which must always be made by specific gravity, that is, by weight, should only be expressed in the terms in which it is made, namely, by weight; and all degrees, whether of any arbitrary scale, as that of Baumé, or above or below proof, or percentage by volume, should be discouraged and disused as rapidly as possible.

The disturbing influence of temperature is also a grave complication in this determination of strength, since, as above stated, an average of about 3° C.=5½° F., is equal to about 1 per cent. or two cents per gallon for the stronger grades of alcohol. Observations must be made within this limit of temperature, therefore, to get within 1 per cent. of true strength. Most determinations and researches have been made and most tables are constructed for a temperature of 60° F.=15⅝° C., and hence corrections for temperature are indispensable to any useful degree of accuracy. Such corrections are difficult and complicated except when made by tables, and convenient and compact tables are rarely at hand, so that the best

and most convenient plan is to bring the liquid to a given temperature in order to make the determination. The standard temperature of 60° F.=15⅝° C. is not a natural one for living-rooms or even for storehouses, and it is quite impracticable to reduce a sample from each barrel to such a temperature within a reasonable time. But if an equivalent for the standard temperature be adopted, and this be about the average temperature of liquids throughout the year in the houses of temperate climates, but certainly above this rather than below it, then a sample of liquid might be always quickly and easily brought to such a temperature by the warmth of the hand on the outside of the sample jar. About such a temperature the writer has found at 25° C.=77° F. Now if the readings of an hydrometer be known for these two temperatures, namely, 15⅝° C.= 60° F., and 25° C.=77° F., in the same liquid, then of course the two readings are equivalent, and it does not matter, in an everyday practical sense, whether the liquid be cooled down to the lower temperature or warmed up to the higher. For example, it is known that a given combination of absolute alcohol and water has a specific gravity of 0.8172 at 15⅝° C.=60° F., and that this is equivalent to 92 per cent. by weight of absolute alcohol. Now, if this liquid be warmed up to 25° C.=77° F., it will show by the same hydrometer an apparent specific gravity of 0.8091. Now, if an unknown sample of spirit give the latter reading at the latter temperature, the reading for the standard temperature would be equally known, and, therefore, the strength would be 92 per cent. by weight.

The great drawback to a more common use of specific gravity as an indication of strength in liquids is the difficulty or inconvenience of reducing the temperature to the low standard of 60° F., which has been of late years universally adopted, because the cooling of liquids down to that temperature is always tedious and troublesome, and during a large portion of the year is impracticable without the use of ice. But when the practical need and value of a test of strength which is so widely and so generally applicable is considered, it seems well worth while to attempt to overcome this great drawback, that the more frequent and common use of specific gravity may be encouraged in the hands of consumers.

In order to favor this, and to awaken buyers of spirits and alcohol, who buy for consumption or actual use, to a little more intelligence and practical economy in the management of their interest in this important commodity, the writer has constructed a general table, not scientifically accurate, but sufficiently accurate for everyday practical use, and offers it herewith.

To get some facts as to the necessity for more knowledge as to what is bought for "95 per cent. alcohol" by those who really intend to have that grade of strength, the writer sent to twenty first-class pharmacists and druggists, and bought one or two pints of their best and strongest alcohol without regard to cost. The wholesale houses very generally charged 40 cents a pint, though sometimes 50 cents, while the retailers generally charged 50 cents.

One wholesale house charged 35 cents, so that the intention to have and to sell the very strongest was very apparent. One sample only approached as near as 94¼ per cent. by volume. Specific gravity 0.8175 at 15⅝° C.=60° F. Two other samples gave 0.8190, or a little more than 94 per cent. by volume. Ten were between 93 and 93¾ per cent. by volume, and seven were between 92½ and 93 per cent. by volume.

EXPLANATION OF TABLE.

This table has no claim to scientific accuracy or precision, but only aims to be moderately correct to within one-half of one per cent. The maximum error for the readings of any single line across the Table is scarcely more than one-quarter of one per cent.; but in some few instances where one line is compared with the next below it, the sum of the two errors will reach one-half of one per cent. In the columns for specific gravity the figure of the fourth decimal place is given only to qualify the value of the figure of the third decimal place; that is, when the figure of the fourth or last decimal place is 4, or less than 4, the three preceding figures are to be read and accepted as they stand. But when the figure of the fourth decimal place is 5, or is greater than 5, the figure of the third place is to be increased by 1.

As the hydrometers and thermometers of the ordinary market, with which the table must be used, do not approach precision nearer than one-half of one per cent., all that could be very practically useful in the Table would be to get within their range of error. At least this is all that has been attempted.

So far as regards the relation between specific gravities and percentage, the Table is a mere compilation or copy from various good authorities, but as these authorities do not agree upon the starting-point, namely, the specific gravity of absolute alcohol, of course their Tables do not agree with precision when placed beside each other. Indeed it is very doubtful whether any of the authorities have yet obtained absolute alcohol; and therefore more accurate research upon this point is needed. The table of Fownes gives the specific gravity of anhydrous or absolute alcohol as 0.7938; that of Tralles gives it as 0.7946, both at 15⅝° C.=60° F., and both as compared with pure water at the same temperature taken as unity. More recent investigation gives a lower density, and the writer has frequently seen it as low as 0.7934, but no tables have been constructed upon these better data.

As the Table is a long one, it is for convenience of reference divided into seven parts, each embracing a grade of spirits used for different purposes. The first and second parts are for weak liquors, the third for low wines, the fourth for whiskies, brandies, etc., the fifth and sixth for high wines, and the seventh for alcohol.

Although revised with care, and the voluminous calculations checked, and the results reviewed by their differences, it is yet not improbable that slight errors may have escaped detection.

The first column of the table contains specific gravities at $15\frac{5}{9}°$ C. $=60°$ F., compared with pure water at the same temperature taken as unity, for spirit of every degree of strength, by the four scales or methods of stating strength now in common use, namely, percentage by weight, percentage by volume, percentage under and over proof, and percentage of proof spirit. The specific gravities for percentage by weight are copied literally from a table by Fownes, given in his Manual of Elementary Chemistry, Amer. edition of 1869, p. 830. These are believed to be most accurate and trustworthy.

The specific gravities for percentage by volume are given from Watt's Dictionary of Chemistry, vol. 1, p. 84, *et. seq.*, where they are quoted as determined by Tralles from the observations of Gilpin. This table is less trustworthy than that of Fownes only in adopting too high a specific gravity for anhydrous alcohol. It is not literally copied here; but where its specific gravities were within two or three-tenths of one per cent. of being the same as those of Fownes, they were accepted as being practically in accord with Fownes, and his figures were allowed to represent them in order to condense the Table.

The specific gravities for percentage under and over proof are partly copied and partly deduced by interpolation from a table of Dr. Ure, given in his Dictionary of Arts, Manufactures and Mines, Eng. edition of 1860, vol. 1, pp. 57 and 58. This method of stating the percentage under or over proof is that adopted by the British Board of Excise, and it is applied by Sykes' hydrometer. In Dr. Ure's table, however, 0.9200 is given as the specific gravity of proof spirit, while in his text at p. 44 it is given on the authority of Drink-water as 0.919. This table of Dr. Ure is not copied literally, but his figures are altered to coincide with those of Fownes and Tralles, wherever the values are not affected beyond the limit of error admitted in the design of this Table as above stated.

The specific gravities for percentage of proof spirit are taken from the Manual for Gaugers of Spirits, published by authority of the Treasury Department of the United States in 1870. This is the method of stating strength which is used by the United States Internal Revenue Department; and it is peculiar in introducing a new strength and definition for the term "proof spirit," namely, "that alcoholic liquor which contains one-half its volume of alcohol of a specific gravity of ·7939 at 60° Fahrenheit." The specific gravity of such proof spirit is stated to be ·93353 at 60° F. Water at its maximum density being taken as unity. The British legal definition of "proof spirit," describes it as "such as shall, at the temperature of fifty-one degrees of Fahrenheit's thermometer, weigh exactly twelve-thirteenth parts of an equal measure of distilled water." The specific gravity of this "proof spirit" is stated to be 0.919 at 60° F. This latter is the older and long-accepted proof spirit, and it is probable that few who use the term "proof spirit" in this country know that it has been legally applied to an inferior

strength. The old commercial usage of quoting price upon "proof" strength, and increasing or diminishing this by percentage as this spirit is above or below "proof," is the chief argument for this method. This method also introduces a very peculiar use of language in such expressions as "one hundred and eighty per cent." That is, one hundred and eighty to the hundred; the greater included within the less. This Table III. of the Government Manual is not copied literally, but is treated in the same manner as that for percentage under and over proof, in making numbers which are of nearly the same value read as though they were in actual coincidence.

The specific gravities given in the second column of the Table, namely, those at 25° C.=77° F., are deduced by applying to the specific gravities of the first column, the differences for temperature given in a table quoted from Tralles in Watt's Dictionary of Chemistry, vol. 1, p. 88, the deficiencies in the table quoted being supplied by interpolation. Though this column cannot be entirely trustworthy, its range of error is in all probability well within that of ordinary hydrometers, or even specific-gravity bottles; and is within the moderate degree of accuracy claimed for the entire Table.

The seventh column of the Table is the weight in grammes of one gallon of spirit of all the various strengths, at $15\frac{5}{9}$° C.=60° F. This and all the succeeding columns are given upon the authority of the writer. The laborious calculations involved were made at such intervals as could be taken from an active business. But as they have been re-examined and checked by more competent arithmeticians, it is hoped that they may be free from serious practical errors.

The first step was to ascertain the weight of a gallon of distilled water at $15\frac{5}{9}$° C.=60° F. This, which was at first supposed to be only difficult, proved in the end to be impossible, because no U. S. law could be found establishing the standard gallon, and after careful inquiry at Washington it is believed that no such law is in existence. Various authorities, however, give the value of what they call the U. S. legal gallon as 231 cubic inches, or 58372.1757 grains of pure water at its maximum density of 39.83° F. As this temperature is not that of the maximum density of water, but rather 3.945° C.=39.101° F., as determined by Playfair and Joule, there must be a small error from temperature in this determination. It was, however, accepted as the best attainable authority. It next became necessary to get the weight of this gallon at the temperature of $15\frac{5}{9}$° C.=60° F. This has been frequently determined and published at different values, varying within a range of ten grains. This was too great a diversity even for the low degree of accuracy aimed at in the design of this Table, and therefore a new determination from more modern data was undertaken. In Poggendorff's Annalen, vol. 72, p. 1 to 223, Kopp has given a more accurate table of the expansion of water by heat than had been before attained. Applying his results to the so-called U. S. legal gallon, the weight

of pure water at 15⅔ C.=60° F. (without correction for difference in density or displacement for either weights or air between this temperature and that given as the maximum density of water), is 58319 5714 grains. When this deduced weight of the so-called standard gallon is checked by the new weight of the cubic inch of water, as corrected from the determinations of Captain Kater by Prof. F. A. P. Barnard (see "The Metric System, by F. A. P. Barnard," 1872, p. 167), it is found to be, though not with scientific precision, in accordance with this latest good authority, yet sufficiently near for the purposes of this Table. It is, therefore, accepted as being practically correct, although it is from 7 to 10 grains less than the weight given by good authorities. For the use of this Table, 58320 grains is adopted as being true to the nearest grain, and the eighth column of the Table, or the weight of one gallon at 15⅔° C.=60° F. in grains, is obtained by multiplying the specific gravities at 15⅔° C.=60° F. by 58320, and accepting the nearest grain for the final figure. The seventh column, or the weight of one gallon at 15⅔° C.=60° F. in grammes, is obtained by dividing the weight in grains by 15.432, or the value of a gramme in grains.

The ninth, tenth and eleventh columns are together equivalent to the eighth column, the grains being here expressed in the commercial avoirdupois weight of pounds, ounces and grains.

The twelfth and thirteenth columns, taken together, give the avoirdupois pounds and ounces to the nearest ounce.

The thirteenth column gives the weight to the nearest half pound of forty gallons at 15⅔° C.=60° F. It is obtained by multiplying the figures of the eighth column by 40, and reducing the grains to pounds.

The fourteenth column is the weight of a pint at 15⅔° C.=60° F. in grammes; and the fifteenth is the weight of the same quantity, at the same temperature, in grains. These columns are obtained by dividing the figures of the seventh and eighth columns by 8.

USE OF THE TABLE.

This Table is susceptible of being used for many purposes and in many ways, since any quantity of any column being known, the corresponding quantities in all the other columns may be known by simple inspection. For example, if a spirit be known to contain 52 per cent. of absolute alcohol by weight, by seeking out this number in the column of percentage by weight, it will be found to contain 60 per cent. by volume; or to be 5 per cent. over proof; or to contain 120 per cent. of proof spirit. Its specific gravity at 15⅔° C.= 60° F. will be 0.9135, or at 25° C.=77° F. will be 0.9056. The weight of a gallon, at the standard temperature given, will be 3452.24 grammes, or 53275 grains, or 7 lbs. 9 oz. 338 grains, or, practically, 7 lbs. 10 oz. The weight of 40 gallons, at the standard temperature, will be 304.5 lbs., and the weight of one pint will be 431.53 grammes, or 6659 grains.

One of the chief uses of the Table, however, is to verify or control the uncertain and difficult process of measuring by volume by the more easy and accurate process of measuring by weight; and of determining the true proportion of absolute alcohol by weight. In order to use it for such purposes, an hydrometer and jar, and a thermometer, are necessary. Let a sample be taken from the barrel by means of a thief, or a small rubber-tubing siphon into the hydrometer jar. Then, if the hydrometer be—as it should be—one with a specific-gravity scale, and adjusted for $15\frac{5}{9}°$ C. $=60°$ F., the sample may be either cooled down to this temperature, or, what is much more convenient and easy, be warmed up by the warmth of the hand to $25°$ C.$=77°$ F. This adjustment of the temperature is greatly accelerated by stirring the liquid with the long tubular thermometer, and the hand that warms the glass should grasp it round the lower part of the cylinder. If the hydrometer to be used indicates, instead of specific gravities, simply percentage by weight, or percentage by volume, or percentage over and under proof, or percentage of proof spirit, then the temperature must be adjusted to that given on the stem of the instrument. The hydrometer is then placed in the liquid and carefully read. That column of the table to which the hydrometer belongs is then sought, and when the figure which corresponds to the reading is found, all the required data will be found upon the same line.

For example: Suppose the spirit from a barrel, when warmed up to $25°$ C.$=77°$ F., be found to have, by the second column, an apparent sp. gr. of 0.9056, then its true sp. gr. would be 0.9135, it would contain 52 per cent. by weight, or 60 per cent. by volume of absolute alcohol, would be 5 per cent. over proof, or would contain 120 per cent. of U. S. proof spirit. A gallon of it at standard temperature would weigh 3452.24 grammes, or 53275 grains, or 7 lbs. 9 oz. 338 grains, or practically 7 lbs. 10 oz.; and 40 gallons of it would weigh $304\frac{1}{2}$ lbs. Now suppose the barrel to weigh 389 lbs. gross, and to have a marked or ascertained tare of 61 lbs., giving a net weight of 328 lbs. of spirit. Then the weight of 40 gallons, namely, $304\frac{1}{2}$ lbs., subtracted from this would leave a remainder of $23\frac{1}{2}$ lbs., which is 10 oz. more than three times the weight of a single gallon of 7 lbs. 10 oz. Therefore, the barrel would contain practically 43 gallons and about $\frac{2}{3}$ pint, this latter fraction being disregarded. And this would be the actual precise measure at the standard temperature, no matter at what temperature the spirit might be when weighed. If several or many barrels had to be measured or verified, and the tares of the barrels not known, it would only be necessary to start with one empty barrel, and then pass the spirit by a siphon or pump from one barrel to another until all the tares were obtained. With an established custom of using barrels with marked tares, the verification would of course be much more simple and easy. Even if every package has to be emptied to obtain the tares, the verification by weight is far quicker, and far less wasteful as well as more accurate, than by

measuring, thus saving much time, and expense, and loss, in cases of disputed gauging in the spirit market.

If the hydrometer in use indicates strength by any of the scales given in the Table other than by specific gravity, and the sample be cooled to the temperature given on the instrument, it is of course used in the same way by looking for its indication in its appropriate column.

The consumer who buys his alcohol or spirit in smaller quantities, can still more easily verify his purchases by the use of tared vessels. And when the time comes that the absolute alcohol in any spirit shall be sold by the pound, the whole matter of control will be very plain and simple, and all true interests be best subserved.

In the use of the Table by the pharmacist to control the results of repercolation for making fluid extracts, the weight of the pint of menstruum of all strengths will be found very useful. It will also be useful to those who have substituted weights for measures in the use of alcoholic liquids in making tinctures, etc.

Brooklyn, September, 1873.

TABLE.

The table being constructed upon two bases is thus adapted to the common uses of the present time. Fownes is the authority for the percentages by weight, and Tralles for percentages by volume. As these authorities, though in common use, are not in accord on the important point of the density of absolute alcohol, their strengths for the mixtures of alcohol and water are not in accord.

Fownes gives ·7938 at 15.6° C.=60° F., compared with water at 15.6° C.=60° F. as unity, for absolute alcohol, and Tralles ·7946. But until a more correct usage requires all tables to be revised, and until the national governments take the lead in such revision, it is best not to disturb the common usage, simply acknowledging the tables to be erroneous.

It is now shown that the s.g. of nearly absolute alcohol at 15.6° C. =60° F., compared with water at 15.6° C.=60° F., can hardly be above ·79353, and is more likely to be ·79350. But if the alcohol could be made quite anhydrous it would be a little lower than this. The difference in strength between Fownes' ·7938, and the writer's ·7935, or ·0003, is equivalent to about one-tenth of one per cent., and at the present high cost of alcohol is about 20 cents on each barrel. This is a diminishing difference, and can be applied only to the higher strengths of the table. It is removed to the fifth decimal place before the middle of the table is reached, and then gets beyond the nominal scope of the table.

TABLE FOR DISTILLED SPIRITS AND ALCOHOL.

PART I.—From 0 to 10 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60° F.						Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60° F	Weight of one pint, at 15⅝° C.=60° F.	
								Avoirdupois Weig't.						
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Under proof. (Brit. Excise.)	Of proof spirit. (U.S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	To the nearest ounce. lbs.	ozs	lbs.	In Grms.	In Grs.
1.0000	0.9986					3779.13	58,320	8	5	132	8	5	333.5	472.39	7290
0.9993	0.9978			99	1	3776.50	58,279	8	5	91	8	5	333.0	472.06	7285
0.9985	0.9970		1	98	2	3773.46	58,232	8	5	44	8	5	332.5	471.68	7279
0.9981	0.9966	1				3771.97	58,209	8	5	22	8	5	332.5	471.49	7276
0.9976	0.9961			97	3	3770.08	58,180	8	4	430	8	5	332.5	471.26	7272
0.9970	0.9953		2		4	3767.82	58,145	8	4	395	8	5	332.0	470.98	7268
0.9968	0.9951			96		3767.04	58,133	8	4	383	8	5	332.0	470.88	7267
0.9965	0.9948	2			5	3765.94	58,116	8	4	366	8	5	332.0	470.74	7264
0.9960	0.9943			95		3764.06	58,087	8	4	337	8	5	332.0	470.51	7261
0.9956	0.9938		3		6	3762.51	58,063	8	4	313	8	5	332.0	470.31	7258
0.9952	0.9934			94		3761.02	58,040	8	4	290	8	5	331.5	470.13	7255
0.9947	0.9927	3			7	3759.14	58,011	8	4	261	8	5	331.5	469.89	7251
0.9944	0.9924			93		3757.97	57,993	8	4	243	8	5	331.5	469.75	7249
0.9942	0.9922		4		8	3757.26	57,982	8	4	232	8	5	331.5	469.66	7248
0.9936	0.9916			92	9	3754.99	57,947	8	4	197	8	4	331.0	469.37	7243
0.9930	0.9909	4	5	91	10	3752.72	57,912	8	4	162	8	4	331.0	469.09	7239
0.9921	0.9900			90	11	3749.29	57,859	8	4	109	8	4	330.5	468.66	7232
0.9914	0.9893	5	6	89	12	3746.63	57,818	8	4	68	8	4	330.5	468.33	7227
0.9906	0.9885			88	13	3743.65	57,772	8	4	22	8	4	330.0	467.95	7221
0.9900	0.9879			87		3741.38	57,737	8	3	424	8	4	330.0	467.67	7217
0.9898	0.9876	6	7		14	3740.60	57,725	8	3	413	8	4	330.0	467.58	7216
0.9892	0.9870			86	15	3738.33	57,690	8	3	377	8	4	329.5	467.29	7211
0.9890	0.9868		8		16	3737.56	57,678	8	3	366	8	4	329.5	467.19	7210
0.9885	0.9863			85		3735.68	57,649	8	3	336	8	4	329.5	466.96	7206
0.9884	0.9862	7			17	3735.29	57,643	8	3	331	8	4	329.5	466.91	7205
0.9878	0.9855		9	84	18	3733.02	57,608	8	3	296	8	4	329.0	466.63	7201
0.9872	0.9849			83	19	3730.82	57,574	8	3	261	8	4	329.0	466.35	7197
0.9869	0.9846	8	10		20	3729.65	57,556	8	3	243	8	4	329.0	466.21	7194
0.9864	0.9841			82	21	3727.77	57,527	8	3	214	8	3	328.5	465.97	7191
0.9857	0.9834			81		3725.12	57,486	8	3	173	8	3	328.5	465.64	7186
0.9855	0.9831	9	11		22	3724.34	57,474	8	3	161	8	3	328.5	465.54	7184
0.9852	0.9828			80	23	3723.24	57,457	8	3	144	8	3	328.5	465.40	7182
0.9845	0.9821			79		3720.58	57,416	8	3	103	8	3	328.0	465.07	7177
0.9841	0.9816	10	12		24	3719.09	57,393	8	3	81	8	3	328.0	464.89	7174

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART II.—From 10 to 25 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60° F.		Avoirdupois Weig't.					Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60° F	Weight of one pint, at 15⅝° C.=60° F.	
											To the nearest ounce.				
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Under proof. (British Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	lbs	ozs	lbs.	In Grms.	In Grs.
0.9838	0.9813			78	25	3717.92	57,375	8	3	62	8	3	328.0	464.74	7172
0.9831	0.9806			77	26	3715.27	57,334	8	3	21	8	3	327.5	464.41	7167
0.9828	0.9801	11	13		27	3714.17	57,317	8	3	5	8	3	327.5	464.27	7165
0.9825	0.9798			76		3713.00	57,299	8	2	424	8	3	327.5	464.13	7162
0.9821	0.9793		14		28	3711.51	57,276	8	2	401	8	3	327.5	463.94	7159
0.9819	0.9791			75		3710.73	57,264	8	2	389	8	3	327.0	463.84	7158
0.9815	0.9787	12	15		29	3709.24	57,241	8	2	366	8	3	327.0	463.65	7155
0.9813	0.9785			74	30	3708.46	57,229	8	2	354	8	3	327.0	463.56	7154
0.9807	0.9779			73	31	3706.19	57,194	8	2	319	8	3	327.0	463.27	7149
0.9802	0.9773	13	16	72	32	3704.32	57,165	8	2	290	8	3	326.5	463.04	7146
0.9794	0.9765			71	33	3701.33	57,119	8	2	244	8	3	326.5	462.67	7140
0.9789	0.9759	14	17	70	34	3699.33	57,089	8	2	214	8	2	326.0	462.42	7136
0.9784	0.9754			69	35	3697.51	57,060	8	2	185	8	2	326.0	462.19	7132
0.9778	0.9746	15	18	68	36	3695.24	57,025	8	2	150	8	2	326.0	461.90	7128
0.9775	0.9743				37	3694.14	57,008	8	2	123	8	2	326.0	461.77	7126
0.9772	0.9740			67	38	3692.97	56,990	8	2	115	8	2	325.5	461.62	7124
0.9766	0.9733	16	19	66	39	3690.71	56,955	8	2	80	8	2	325.5	461.34	7119
0.9760	0.9726		20	65	40	3688.44	56,920	8	2	45	8	2	325.5	461.05	7115
0.9753	0.9719	17	21	64	41	3685.78	56,879	8	2	4	8	2	325.0	460.72	7110
0.9749	0.9715			63	42	3684.29	56,856	8	1	418	8	2	325.0	460.54	7107
0.9743	0.9709			62	43	3682.02	56,821	8	1	383	8	2	324.5	460.25	7103
0.9741	0.9706	18	22		44	3681.31	56,810	8	1	373	8	2	324.5	460.16	7101
0.9737	0.9702			61	45	3679.76	56,786	8	1	348	8	2	324.5	459.97	7098
0.9732	0.9697			60	46	3677.88	56,757	8	1	319	8	2	324.5	459.73	7095
0.9728	0.9692	19	23	59	47	3676.39	56,734	8	1	297	8	2	324.0	459.55	7092
0.9720	0.9684			58	48	3673.27	56,687	8	1	249	8	2	324.0	459.16	7086
0.9716	0.9678	20	24		49	3671.85	56,664	8	1	227	8	2	324.0	458.98	7083
0.9714	0.9676			57	50	3671.07	56,652	8	1	214	8	1	323.5	458.88	7081
0.9709	0.9668		25	56		3669.19	56,623	8	1	186	8	1	323.5	458.65	7078
0.9704	0.9661	21		55	51	3667.31	56,594	8	1	157	8	1	323.5	458.41	7074
0.9698	0.9655		26	54	52	3665.05	56,559	8	1	122	8	1	323.0	458.13	7070
0.9693	0.9650				53	3663.17	56,530	8	1	92	8	1	323.0	457.90	7066
0.9691	0.9646	22	27	53	54	3662.39	56,518	8	1	81	8	1	323.0	457.80	7065
0.9683	0.9638			52	55	3659.36	56,471	8	1	33	8	1	322.5	457.42	7059
0.9678	0.9631	23	28	51	56	3657.47	56,442	8	1	5	8	1	322.5	457.18	7055
0.9671	0.9624			50	57	3654.81	56,401	8	0	401	8	1	322.5	456.85	7050
0.9665	0.9617	24	29	49	58	3652.54	56,366	8	0	366	8	1	322.0	456.57	7046
0.9658	0.9610			48	59	3649.88	56,325	8	0	325	8	1	322.0	456.24	7041
0.9652	0.9603	25	30	47	60	3647.62	56,290	8	0	290	8	1	321.5	455.95	7036

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART III.—From 25 to 40 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60° F.						Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60° F	Weight of one pint at 15⅝° C.=60° F.	
								Avoirdupois Weig't.						
											To the nearest ounce.			
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Under proof. (British Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	lbs	ozs	lbs.	In Grms.	In Grs.
0.9645	0.9597			46	61	3645.02	56,250	8	0	250	8	1	321.5	455.63	7031
0.9643	0.9594		31		62	3644.24	56,238	8	0	238	8	1	321.5	455.53	7030
0.9638	0.9590	26	.	45	63	3642.37	56,209	8	0	209	8	0	321.0	455.30	7026
0.9631	0.9582		32	44	64	3639.71	56,168	8	0	168	8	0	321.0	454.96	7021
0.9623	0.9574	27		43	65	3636.66	56,121	8	0	121	8	0	320.5	454.58	7015
0.9618	0.9567		33	42	66	3634.79	56,092	8	0	92	8	0	320.5	454.35	7011
0.9609	0.9556	28	34	41	67	3631.42	56,040	8	0	40	8	0	320.0	453.93	7005
0.9602	0.9549			40	68	3628.76	55,999	7	15	436	8	0	320.0	453.59	7000
0.9595	0.9542			39	69	3626.10	55,958	7	15	395	8	0	320.0	453.26	6995
0.9593	0.9538	29	35		70	3625.33	55,946	7	15	383	8	0	319.5	453.17	6993
0.9587	0.9532			38	71	3623.06	55,911	7	15	348	8	0	319.5	452.88	6989
0.9578	0.9521	30	36	37	72	3619.69	55,859	7	15	296	8	0	319.0	452.46	6982
0.9572	0.9515			36	73	3617.42	55,824	7	15	261	8	0	319.0	452.18	6978
0.9565	0.9507		37	35		3614.76	55,783	7	15	220	8	0	319.0	451.84	6973
0.9560	0.9500	31			74	3612.88	55,754	7	15	191	7	15	318.5	451.61	6969
0.9555	0.9495			34	75	3611.03	55,725	7	15	162	7	15	318.5	451.38	6966
0.9550	0.9489		38	33	76	3609.12	55,696	7	15	133	7	15	318.0	451.14	6962
0.9544	0.9482	32			77	3606.86	55,661	7	15	98	7	15	318.0	450.86	6958
0.9539	0.9577			32		3604.91	55,631	7	15	68	7	15	318.0	450.61	6954
0.9535	0.9473		39		78	3603.42	55,608	7	15	45	7	15	318.0	450.43	6951
0.9528	0.9465	33		31	79	3600.76	55,567	7	15	4	7	15	317.5	450.09	6946
0.9519	0.9456		40	30	80	3597.39	55,515	7	14	390	7	15	317.0	449.67	6939
0.9511	0.9446	34		29	81	3594.35	55,468	7	14	343	7	15	317.0	449.29	6933
0.9503	0.9438		41	28	82	3591.30	55,421	7	14	296	7	15	316.5	448.91	6928
0.9495	0.9430			27	83	3588.32	55,375	7	14	250	7	15	316.5	448.54	6922
0.9490	0.9424	35	42		84	3586.44	55,346	7	14	221	7	15	316.0	448.30	6918
0.9485	0.9419			26		3584.56	55,317	7	14	192	7	14	316.0	448.07	6915
0.9475	0.9409			25	85	3580.74	55,258	7	14	133	7	14	316.0	447.59	6907
0.9470	0.9402	36	43		86	3578.86	55,229	7	14	104	7	14	315.5	447.36	6904
0.9465	0.9397			24		3576.98	55,200	7	14	75	7	14	315.5	447.12	6900
0.9455	0.9387			23	87	3573.22	55,142	7	14	17	7	14	315.0	446.65	6893
0.9452	0.9382	37	44		88	3572.06	55,124	7	13	437	7	14	315.0	446.51	6890
0.9446	0.9376			22	89	3569.79	55,089	7	13	401	7	14	315.0	446.22	6886
0.9434	0.9363	38	45	21	90	3565.25	55,019	7	13	331	7	14	314.5	445.66	6877
0.9426	0.9355			20	91	3562.21	54,972	7	13	284	7	14	314.0	445.28	6871
0.9416	0.9343	39	46	19	92	3558.45	54,914	7	13	226	7	14	314.0	444.81	6864
0.9405	0.9332			18	93	3554.30	54,850	7	13	162	7	13	313.5	444.29	6856
0.9396	0.9323	40	47	17	94	3550.87	54,797	7	13	109	7	13	313.0	443.86	6850
0.9391	0.9318				95	3548.99	54,768	7	13	75	7	13	313.0	443.62	6846

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART IV.—From 40 to 55 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60° F.							Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60° F	Weight of one pint, at 15⅝° C.=60° F.	
								Avoirdupois Weig't.							
											To the nearest ounce.				
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Under proof. (British Excise.)	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	lbs	ozs	lbs.	In Grms.	In Grs.
0.9381	0.9307		48	16	96	3545.23	54,710	7	13	22	7	13	312.5	443.15	6839
0.9376	0.9302	41				3543.35	54,681	7	12	431	7	13	312.5	442.92	6835
0.9373	0.9300			15	97	3542.19	54,663	7	12	413	7	13	312.5	442.77	6833
0.9362	0.9288		49	14	98	3538.04	54,599	7	12	349	7	13	312.0	442.25	6825
0.9356	0.9280	42				3535.77	54,564	7	12	314	7	13	312.0	441.97	6820
0.9352	0.9276			13	99	3534.28	54,541	7	12	291	7	13	311.5	441.78	6818
0.9343	0.9267		50	12	100	3530.84	54,488	7	12	238	7	13	311.5	441.35	6811
0.9335	0.9259	43			101	3527.86	54,442	7	12	192	7	12	311.0	440.98	6805
0.9329	0.9253			11		3525.59	54,407	7	12	157	7	12	311.0	440.70	6801
0.9323	0.9246		51		102	3523.33	54,372	7	12	122	7	12	310.5	440.42	6796
0.9318	0.9242			10		3521.45	54,343	7	12	93	7	12	310.5	440.18	6793
0.9314	0.9237	44			103	3519.89	54,319	7	12	69	7	12	310.5	439.99	6790
0.9306	0.9230			9		3516.91	54,273	7	12	23	7	12	310.0	439.61	6784
0.9303	0.9226		52		104	3515.75	54,255	7	12	5	7	12	310.0	439.47	6782
0.9292	0.9214	45		8	105	3511.59	54,191	7	11	379	7	12	309.5	438.95	6774
0.9283	0.9205		53	7	106	3508.16	54,138	7	11	326	7	12	309.5	438.52	6767
0.9270	0.9192	46		6	107	3503.30	54,063	7	11	251	7	12	309.0	437.91	6758
0.9262	0.9184		54	5	108	3500.26	54,016	7	11	204	7	11	308.5	437.53	6752
0.9249	0.9171	47		4	109	3495.33	53,940	7	11	128	7	11	308.0	436.92	6742
0.9242	0.9164		55		110	3492.68	53,899	7	11	87	7	11	308.0	436.58	6737
0.9236	0.9158			3		3490.41	53,864	7	11	51	7	11	308.0	436.30	6733
0.9228	0.9150	48			111	3487.43	53,818	7	11	6	7	11	307.5	435.93	6727
0.9221	0.9143		56	2	112	3484.77	53,777	7	10	402	7	11	307.5	435.60	6722
0.9212	0.9134			1	113	3481.34	53,724	7	10	349	7	11	307.0	435.17	6715
0.9206	0.9128	49				3479.07	53,689	7	10	314	7	11	307.0	434.88	6711
0.9200	0.9122		57	Proof over.	114	3476.80	53,654	7	10	279	7	11	306.5	434.60	6707
0.9189	0.9111			1	115	3472.65	53,590	7	10	215	7	10	306.0	434.08	6699
0.9184	0.9106	50				3470.77	53,561	7	10	186	7	10	306.0	433.85	6695
0.9178	0.9100		58	2	116	3468.51	53,526	7	10	151	7	10	306.0	433.56	6691
0.9168	0.9090				117	3464.75	53,468	7	10	93	7	10	305.5	433.09	6684
0.9160	0.9081	51	59	3	118	3461.70	53,421	7	10	46	7	10	305.0	432.71	6678
0.9150	0.9071			4	119	3457.94	53,363	7	9	425	7	10	305.0	432.24	6670
0.9135	0.9056	52	60	5	120	3452.24	53,275	7	9	338	7	10	304.5	431.53	6659
0.9124	0.9045			6	121	3448.09	53,211	7	9	273	7	10	304.0	431.01	6651
0.9113	0.9034	53	61	7	122	3443.95	53,147	7	9	210	7	9	303.5	430.49	6643
0.9100	0.9021			8	123	3439.02	53,071	7	9	133	7	9	303.0	429.88	6634
0.9090	0.9011	54	62	9	124	3435.26	53,013	7	9	76	7	9	303.0	429.41	6627
0.9075	0.8995			10	125	3429.56	52,925	7	8	425	7	9	302.5	428.69	6616
0.9069	0.8989	55	63		126	3427.29	52,890	7	8	390	7	9	302.0	428.41	6611

PART V.—From 55 to 70 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60° F.							Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60° F	Weight of one pint, at 15⅝° C.=60° F.	
								Avoirdupois Weig't.							
											To the nearest ounce.				
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Over proof. (British Excise.)	Of proof spirit. (U.S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	lbs	ozs	lbs.	In Grms.	In Grs.
0.9062	0.8982			11	127	3424.70	52,850	7	8	350	7	9	302.0	428.09	6606
0.9047	0.8969	56	64	12	128	3419.00	52,762	7	8	262	7	9	301.5	427.37	6595
0.9036	0.8958			13		3414.85	52,698	7	8	198	7	8	301.0	426.86	6587
0.9025	0.8947	57	65		129	3410.70	52,634	7	8	134	7	8	301.0	426.34	6579
0.9021	0.8943			14	130	3409.15	52,610	7	8	110	7	8	300.5	426.14	6576
0.9008	0.8930			15	131	3404.29	52,535	7	8	35	7	8	300.0	425.54	6567
0.9001	0.8923	58	66		132	3401.63	52,494	7	7	432	7	8	300.0	425.20	6562
0.8994	0.8916			16	133	3398.98	52,453	7	7	390	7	8	299.5	424.87	6557
0.8979	0.8901	59		17		3393.34	52,366	7	7	304	7	8	299.0	424.17	6546
0.8973	0.8895		67		134	3391.07	52,331	7	7	269	7	8	299.0	423.88	6541
0.8966	0.8888			18		3388.41	52,290	7	7	227	7	8	299.0	423.55	6536
0.8956	0.8878	60			135	3384.59	52,231	7	7	169	7	7	298.5	423.07	6529
0.8953	0.8875			19		3383.49	52,214	7	7	151	7	7	298.5	422.94	6527
0.8949	0.8870		68		136	3382.00	52,191	7	7	129	7	7	298.0	422.75	6524
0.8938	0.8859			20	137	3377.79	52,126	7	7	63	7	7	298.0	422.22	6516
0.8932	0.8853	61				3375.52	52,091	7	7	29	7	7	297.5	421.94	6511
0.8925	0.8846		69	21	138	3372.93	52,051	7	6	426	7	7	297.5	421.62	6506
0.8910	0.8831			22	139	3367.22	51,963	7	6	338	7	7	297.0	420.90	6495
0.8908	0.8829	62				3366.45	51,951	7	6	326	7	7	297.0	420.81	6494
0.8900	0.8821		70		140	3363.47	51,905	7	6	280	7	7	296.5	420.43	6488
0.8897	0.8818			23		3362.30	51,887	7	6	262	7	7	296.5	420.29	6486
0.8886	0.8807	63			141	3358.15	51,823	7	6	198	7	6	296.0	419.77	6478
0.8883	0.8804			24		3357.05	51,806	7	6	181	7	6	296.0	419.63	6476
0.8875	0.8796		71		142	3354.00	51,759	7	6	134	7	6	296.0	419.25	6470
0.8869	0.8790			25		3351.74	51,724	7	6	99	7	6	295.5	418.97	6465
0.8863	0.8784	64			143	3349.47	51,689	7	6	64	7	6	295.5	418.68	6461
0.8854	0.8775			26		3346.10	51,637	7	6	12	7	6	295.0	418.26	6455
0.8850	0.8771		72		144	3344.54	51,613	7	5	426	7	6	295.0	418.07	6452
0.8840	0.8761	65		27	145	3340.78	51,555	7	5	368	7	6	294.5	417.60	6444
0.8825	0.8746		73	28	146	3335.08	51,467	7	5	279	7	6	294.0	416.88	6433
0.8816	0.8736	66				3331.71	51,415	7	5	228	7	6	294.0	416.46	6427
0.8811	0.8731			29	147	3329.83	51,386	7	5	198	7	5	293.5	416.23	6423
0.8799	0.8719		74	30	148	3325.30	51,316	7	5	129	7	5	293.0	415.66	6414
0.8793	0.8713	67			149	3323.03	51,281	7	5	94	7	5	293.0	415.38	6410
0.8783	0.8703			31		3319.21	51,222	7	5	34	7	5	292.5	414.90	6403
0.8769	0.8689	68	75	32	150	3313.96	51,141	7	4	391	7	5	292.0	414.25	6393
0.8754	0.8674			33	151	3308.25	51,053	7	4	303	7	5	291.5	413.53	6382
0.8745	0.8665	69	76		152	3304.89	51,001	7	4	251	7	5	291.5	413.11	6375
0.8739	0.8659			34	153	3302.62	50,966	7	4	216	7	4	291.0	412.83	6371
0.8721	0.8641	70	77	35	154	3295.81	50,861	7	4	111	7	4	290.5	411.98	6358

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART VI.—From 70 to 85 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60° F.						Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60° F	Weight of one pint at 15⅝° C.=60° F.	
								Avoirdupois Weig't.						
											To the nearest ounce.			
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Over proof. (British Excise.)	Of proof spirit. (U.S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	lbs	ozs	lbs.	In Grms.	In Grs.
0.8708	0.8628			36	155	3290.89	50,785	7	4	35	7	4	290.0	411.36	6348
0.8696	0.8616	71	78	37		3286.35	50,715	7	3	403	7	4	290.0	410.79	6339
0.8693	0.8613				156	3285.25	50,698	7	3	385	7	4	289.5	410.66	6337
0.8678	0.8598			38	157	3279.55	50,610	7	3	297	7	4	289.0	409.94	6326
0.8672	0.8591	72			158	3277.28	50,575	7	3	263	7	4	289.0	409.66	6322
0.8664	0.8583		79	39		3274.23	50,528	7	3	216	7	3	288.5	409.28	6316
0.8649	0.8568	73			159	3268.59	50,441	7	3	129	7	3	288.0	408.57	6305
0.8646	0.8565			40		3267.43	50,423	7	3	110	7	3	288.0	408.43	6303
0.8639	0.8558		80		160	3264.84	50,383	7	3	71	7	3	288.0	408.10	6298
0.8631	0.8550			41		3261.79	50,336	7	3	23	7	3	287.5	407.72	6292
0.8625	0.8544	74				3259.53	50,301	7	2	426	7	3	287.5	407.44	6288
0.8615	0.8534			42	161	3255.77	50,243	7	2	368	7	3	287.0	406.97	6280
0.8611	0.8530		81		162	3254.21	50,219	7	2	344	7	3	287.0	406.78	6277
0.8603	0.8522	75			163	3251.23	50,173	7	2	298	7	3	286.5	406.40	6272
0.8599	0.8518			43		3249.68	50,149	7	2	274	7	3	286.5	406.21	6269
0.8581	0.8500	76	82	44	164	3242.87	50,044	7	2	169	7	2	286.0	405.36	6255
0.8566	0.8485			45	165	3237.23	49,957	7	2	82	7	2	285.5	404.65	6245
0.8557	0.8476	77	83			3233.80	49,904	7	2	29	7	2	285.0	404.22	6238
0.8550	0.8469			46	166	3231.21	49,864	7	1	426	7	2	285.0	403.90	6233
0.8539	0.8458				167	3227.00	49,799	7	1	361	7	2	284.5	403.38	6225
0.8533	0.8452	78		47		3224.73	49,764	7	1	327	7	2	284.5	403.09	6220
0.8526	0.8444		84		168	3222.14	49,724	7	1	287	7	2	284.0	402.77	6215
0.8516	0.8434			48		3218.31	49,665	7	1	227	7	2	284.0	402.29	6208
0.8508	0.8426	79			169	3215.33	49,619	7	1	182	7	1	283.5	401.92	6202
0.8501	0.8419			49	170	3212.67	49,578	7	1	140	7	1	283.5	401.58	6197
0.8496	0.8414		85			3210.79	49,549	7	1	112	7	1	283.0	401.35	6194
0.8483	0.8401	80		50	171	3205.87	49,473	7	1	36	7	1	282.5	400.73	6184
0.8466	0.8384		86	51	172	3199.46	49,374	7	0	374	7	1	282.0	399.93	6172
0.8459	0.8377	81				3196.80	49,333	7	0	333	7	1	282.0	399.60	6167
0.8450	0.8368			52	173	3193.36	49,280	7	0	280	7	1	281.5	399.17	6160
0.8434	0.8352	82	87	53	174	3187.34	49,187	7	0	187	7	0	281.0	398.42	6148
0.8415	0.8333			54	175	3180.15	49,076	7	0	76	7	0	280.5	397.52	6134
0.8408	0.8326	83	88			3177.49	49,035	7	0	35	7	0	280.0	397.19	6129
0.8396	0.8314			55	176	3172.95	48,965	6	15	402	7	0	280.0	396.62	6121
0.8387	0.8305				177	3169.58	48,913	6	15	350	7	0	279.5	396.20	6114
0.8382	0.8300	84				3167.70	48,884	6	15	322	7	0	279.5	395.96	6110
0.8376	0.8294			56		3165.44	48,849	6	15	286	7	0	279.0	395.68	6106
0.8373	0.8291		89		178	3164.27	48,831	6	15	269	7	0	279.0	395.53	6104

TABLE FOR DISTILLED SPIRITS AND ALCOHOL (*continued*).

PART VII.—From 85 to 100 per cent. of Absolute Alcohol.

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.				Weight of one gallon, at 15⅝° C.=60° F.		Avoirdupois Weig't.				Weight of 40 gallons to the nearest half pound, at 15⅝° C.=60° F lbs.	Weight of one pint, at 15⅝° C.=60° F.	
											To the nearest ounce.			
At 15⅝° C. =60° F.	At 25° C.= 77° F.	By weight.	By volume.	Over proof. (British Excise).	Of proof spirit. (U. S. Revenue.)	In Grammes.	In Grains.	lbs	ozs	Grs.	lbs	ozs		In Grms.	In Grs.
0.8357	0.8275	85		57	179	3158.24	48,738	6	15	176	6	15	278.5	394.78	6092
0.8340	0.8258		90		180	3151.83	48,639	6	15	77	6	15	278.0	393.98	6080
0.8336	0.8254			58		3150.34	48,616	6	15	53	6	15	278.0	393.79	6077
0.8331	0.8249	86				3148.39	48,586	6	15	24	6	15	277.5	393.55	6073
0.8317	0.8235			59	181	3143.14	48,505	6	14	380	6	15	277.0	392.89	6063
0.8305	0.8223	87	91		182	3138.61	48,435	6	14	310	6	15	277.0	392.33	6054
0.8298	0.8216			60		3135.95	48,394	6	14	269	6	15	276.5	391.99	6049
0.8288	0.8206				183	3132.19	48,336	6	14	211	6	14	276.0	391.52	6042
0.8279	0.8197	88		61		3128.76	48,283	6	14	158	6	14	276.0	391.09	6035
0.8272	0.8191		92		184	3126.10	48,242	6	14	117	6	14	275.5	390.76	6030
0.8259	0.8178			62		3121.15	48,166	6	14	41	6	14	275.0	390.14	6021
0.8254	0.8173	89			185	3119.30	48,137	6	14	12	6	14	275.0	389.91	6017
0.8240	0.8159			63		3114.05	48,056	6	13	368	6	14	274.5	389.26	6007
0.8237	0.8156		93		186	3112.88	48,038	6	13	351	6	14	274.5	389.11	6005
0.8228	0.8147	90				3109.51	47,986	6	13	299	6	14	274.0	388.69	5998
0.8221	0.8140			64	187	3106.86	47,945	6	13	257	6	14	274.0	388.36	5993
0.8199	0.8118	91	94	65	188	3098.56	47,817	6	13	130	6	13	273.0	387.32	5977
0.8176	0.8095			66	189	3089.81	47,682	6	12	432	6	13	272.5	386.23	5960
0.8172	0.8091	92				3088.32	47,659	6	12	409	6	13	272.5	386.04	5957
0.8164	0.8083		95		190	3085.28	47,612	6	12	362	6	13	272.0	385.66	5951
0.8156	0.8075			67		3082.30	47,566	6	12	316	6	13	272.0	385.29	5946
0.8145	0.8064	93				3078.15	47,502	6	12	252	6	13	271.5	384.77	5938
0.8139	0.8058				191	3075.88	47,467	6	12	217	6	12	271.0	384.48	5933
0.8134	0.8053			68		3073.94	47,437	6	12	187	6	12	271.0	384.24	5930
0.8125	0.8044		96			3070.57	47,385	6	12	135	6	12	271.0	383.82	5923
0.8118	0.8037	94			192	3067.91	47,344	6	12	94	6	12	270.5	383.49	5918
0.8112	0.8031			69		3065.64	47,309	6	12	59	6	12	270.5	383.20	5914
0.8098	0.8017				193	3060.39	47,228	6	11	415	6	12	270.0	382.55	5903
0.8090	0.8009			70		3057.35	47,181	6	11	368	6	12	269.5	382.17	5898
0.8089	0.8008	95				3056.96	47,175	6	11	363	6	12	269.5	382.12	5897
0.8084	0.8003		97		194	3055.08	47,146	6	11	334	6	12	269.5	381.88	5893
0.8061	0.7980	96			195	3046.33	47,011	6	11	200	6	11	268.5	380.79	5876
0.8041	0.7960		98		196	3038.82	46,895	6	11	83	6	11	268.0	379.85	5862
0.8031	0.7950	97				3035.06	46,837	6	11	25	6	11	267.5	379.38	5855
0.8014	0.7933				197	3028.64	46,738	6	10	363	6	11	267.0	378.58	5842
0.8001	0.7920	98				3023.72	46,662	6	10	287	6	11	266.5	377.96	5833
0.7995	0.7914		99			3021.45	46,627	6	10	252	6	11	266.5	377.68	5828
0.7992	0.7911				198	3020.28	46,609	6	10	234	6	11	266.5	377.53	5826
0.7969	0.7888	99			199	3011.59	46,475	6	10	100	6	10	265.5	376.45	5809
0.7946	0.7865		100		200	3002.92	46,341	6	9	404	6	10	265.0	375.37	5793
0.7938	0.7858	100				2999.87	46,294	6	9	357	6	10	264.5	374.98	5787

THE PHARMACOPŒIA OF 1880.

(Review Continued.)

ALCOHOL.

ALCOHOL.

A liquid composed of 91 per cent. by weight (94 per cent. by volume) of Ethyl Alcohol [C_2H_5,HO ; 46.—C_4H_5,O,HO ; 46], and 9 per cent. by weight (6 per cent. by volume) of Water. Sp. gr. 0.820 at 15.6° C. (60° F.) and 0.812 at 25° C. (77° F.)

Alcohol should be preserved in well-closed vessels, in a cool place, remote from lights and fire.

A transparent, colorless, mobile and volatile liquid, of a characteristic, pungent and agreeable odor and a burning taste. It should not change the color of blue or red litmus paper, previously moistened with water. It boils at 78° C. (172.4° F.), and is readily inflammable, giving a blue flame without smoke.

If a portion of at least 50 C.c. be evaporated to dryness in a glass vessel, no residue or color should appear. If mixed with its own volume of water, and one-fifth its volume of glycerin, a piece of blotting paper, on being wet with the mixture, after the vapor of Alcohol has wholly disappeared, should give no irritating or foreign odor (fusel oil). And if a portion be evaporated to one-fifth its volume, the residue should not turn reddish upon the addition of an equal volume of sulphuric acid (amyl alcohol). When treated, in a test-tube, with an equal volume of solution of potassa, there should not be an immediate darkening of the liquid (methyl alcohol, aldehyde and oak tannin). If a portion of about 150 C.c. be digested for an hour with 20 Gm. of carbonate of lead, and filtered, the filtrate then distilled from a water bath, and the first 20 C.c. of the distillate treated with 1 C.c. of test solution of permanganate of potassium, the color should not disappear within one or two minutes (abs. of methyl alcohol). If 20 C.c. are shaken in a glass-stoppered vial, previously well rinsed with the same alcohol, with 2 C.c. of test-solution of nitrate of silver, the mixture should not be rendered more than faintly opalescent during one day's exposure to direct sunlight (abs. of more than traces of foreign organic matters, fusel oil, etc.).

Preparation: Alcohol Dilutum.

The above given tests for this highly important substance are very full and very good, but the three most important ones, when applied as directed, are rendered hypercritical by comparatively unobjectionable and unavoidable organic matter from the barrels, and will not be satisfied with any alcohol that is accessible in the ordinary markets of this country. In applying some of these tests, and in testing generally, throughout the Pharmacopœia, the

testing is much better, more easily and more accurately done by means of a graduated test-tube, and until the present time, this simple and convenient little piece of apparatus has been so difficult to find that the writer has been obliged to make them for himself. Now, however, the well-known manufacturers of glass-ware, Messrs. Whitall, Tatum & Co., of Philadelphia and New York, have offered a very good test-tube graduated to fifths of a cubic centimetre with a sufficient degree of accuracy, up to 30 c.c., and this being a fluidounce, they are adapted to the testing of graduated measures as well.

The first of these tests which no easily accessible alcohol will stand is that wherein a portion is evaporated to one-fifth its volume, and then mixed with an equal volume of sulphuric acid. This test is directed to the detection of amylic alcohol or fusel oil, but small proportions of this impurity escape this test, because the acid does not char the amylic alcohol, while it is particularly sensitive to all kinds of organic matter, which are charred by the acid. It is very doubtful if any alcohol that has been stored in wooden tanks or transported in barrels will even stand this test. The minute proportion of organic matter dissolved by the alcohol will be charred to a reddish brown tinge. The same alcohol, which gives this tint with this test, if distilled from a glass apparatus without contact with organic matter, such as rubber tubing, etc., will withstand the test well, and if to such alcohol a drop of amylic alcohol be added to 100 c.c., it will withstand the test equally well, and yet this proportion is in excess of that found in any ordinary alcohol, and can be detected by the smell without any farther testing. Again, the neutral spirit mentioned at page 548, which is entirely free from amyl and methyl compounds, is tinged reddish brown by sulphuric acid within a few minutes with or without the evaporation directed. The evaporation to one-fifth its volume increases the sensitiveness of this test, but its sensitiveness is for other kinds of organic matter, and not for the amylic alcohol to which it is addressed. Then, as it is not a good test for amylic alcohol, but is a very good test for all kinds of organic matter that is charred by the acid, it is simply misapplied here, and is a duplicate of the nitrate of silver test. And, as a test for organic matter the evaporation is quite unnecessary, because the reaction is sufficiently sensitive, when the acid and alcohol are simply mixed in equal volumes. The depth of the reddish brown tint, which the mixture acquires in half an hour, is a good indication of the amount of the organic matter decomposable by the acid.

The detection of proportions of amylic alcohol so small as not to be detected by simply smelling the alcohol may be effected by the test just above this, namely, by diluting and mixing with glycerin and evaporating. Why this test is directed to fusel oil and the other to amylic alcohol, when the two are identical, is not understood. It is called fusel oil by the distillers, who take it out and sell it, but is crude amylic alcohol, and is so called when in the hands of those who use it. In using alcohol frequently almost every observant person soon becomes familiar with the differences in it at different times, and it is said to be clean or dirty in proportion to the smell of whiskey which can be detected. This whiskey smell is the fusel oil and the ethereal products of its slow decomposition by aging. All ordinary alcohol has traces of this odor to a delicate sense of smell, but no good alcohol has much of it, and to discriminate between good alcohol which has it in very slight degree and poor alcohol which has too much of it, is the object of the Pharmacopœia. The use of the glycerin and water to fix the fusel oil, etc., upon the paper while the alcohol evaporates is a good method of developing the characteristic odor free from the pungency of the alcohol, yet the alcohol as it evaporates carries off so much of the odor with it that most persons will detect it as well and as quickly by trial during the evaporation of the alcohol as after it has gone off, and to such of course the glycerin and water are unnecessary. All they want is to wet a piece of bibulous paper, free from smell, with the alcohol, and smell it during the drying; or, to pour a little out on a delf plate and smell it as it evaporates by causing it to move to and fro. Dilution develops the odor considerably, and this is the use of the water in the Pharmacopœia testing. The experts of the liquor market, who are perhaps the best judges of the cleanness of spirit, simply dilute the spirit and then smell and taste it. They do not even use the moistened paper, although this certainly develops the foreign odors to the sense of smell not specially educated. It is very unfortunate that all the forms of this test have to depend on the delicacy of the sense of smell, because this is so different in different persons without their being aware of the difference.

Methylic alcohol or ether can rarely if ever be present in discoverable proportion in alcohol produced by the column stills of this country, for various reasons. All that can be well present is a very minute proportion which enters as an element into the compound smell called unclean, or that makes the spirit unclean. If one per

cent. of rectified wood spirit or the so-called methylic alcohol be added to any clean spirit it will be perceptible to most persons by simply smelling the mixture. A half of one per cent. would be detected at once by all who are in the habit of handling alcohol, but any such proportions could not be present unless they were added with fraudulent intent. This so called methylic alcohol is commonly a rectified and purified wood spirit, and consists of a mixture in various proportions of methyl alcohol and methyl acetate. The Pharmacopœia test for this substance appears to be constructed so as to decompose the methyl acetate by carbonate of lead and distill off the methylic alcohol with the ethylic alcohol. Then as methylic alcohol is more easily oxidized by permanganate of potassium than the ethylic, the color of the permanganate is sooner changed when the methylic alcohol is present. But the proportion of the impurity must be considerable, and the permanganate must be managed with skill in order to see the difference in the change.

A spirit known to be free from methyl and amyl compounds was taken, and to one part a tenth of a per cent. of rectified wood spirit was added. Both parts were then subjected to the Pharmacopœia test by carbonate of lead, distillation and permanganate. The color did not perceptibly change in either for 10 minutes, and then changed slowly in both, and so nearly alike that no difference could be discovered. In half an hour the red color had not all changed to brown, but both were of a reddish brown. It was very evident that the proportion of permanganate was too large to see any slight change of color, and therefore another test of both together was made using two drops of the test solution of permanganate to each instead of the 1 c.c. as directed. The change of color was quite rapid, so that in 1.5 minutes there was no red tinge but only the brown, and the change was the same in both, both in rapidity and extent. The proportion of wood spirit was then increased to ·3 p.c. and another similar comparison made without a discoverable difference. Then ·5 p.c. was used when both the rate of change and the extent of it were perceptibly increased. But this proportion in the spirit could be recognized by smelling the bottle which contained it. A pair of testings were then made with a part of the clean spirit that had not been digested and distilled with carbonate of lead, two drops of permanganate test solution being used. At the end of 10 minutes they were still distinctly pink in color, and were not decolorized to the brown tint in less than 15 minutes. A portion of the same spirit simply distilled in glass to free it from the matters taken

up from the barrels stood the test for a much longer time, being distinctly pinkish at the end of 25 minutes and not fully brown in half an hour.

Another pair of comparative testings were made with the clean spirit from the barrels. To one tube (20 c.c.) was added ·5 p.c. of the wood spirit, and to each the two drops of permanganate test solution. Here the change from the wood spirit was very marked. In a few seconds the contrast began, and at the end of half a minute the pink color was gone and the brown tinge fully established.

A final testing was then made by adding ·2 p.c. of wood spirit to the clean spirit from the barrels. When held over white paper a difference between the two tubes was perceptible in half a minute, and in five minutes the pink tint was nearly but not quite gone from the tube with the wood spirit, but was quite strong in the other tube. This test is therefore quite as critical without the digestion and distillation from carbonate of lead as with it, but is not critical at all if too much permanganate be used, because the slight changes of color are not perceptible in a deeply colored liquid.

The writer has used the nitrate of silver test for many years, but until the appearance of the new revision of the Pharmacopœia has never applied it in the extremely rigorous way there directed. His practice had always been simply to add a few drops of test solution of nitrate of silver to about 30 c.c. or a fluidounce of the alcohol, and allow it to stand in the diffused daylight of the room for six or eight hours, judging the alcohol by the depth of the brownish tinge produced in all the alcohol or spirits he has ever seen. If the brown tint was deeper than usual, or if a critical test was desired, a small portion of the alcohol was slowly distilled in a glass apparatus without corks or connections of any kind, and with a due guard against the carrying over, by the vapor, of any particles from the retort by bursting bubbles in the boiling. This was in order to free the alcohol from the organic matters taken up from storage tanks, barrels, etc. The barrels are all glued inside to keep the alcohol from taking color from the wood, and this coating of glue is not always thoroughly dried before the alcohol is put in. Then the alcohol, in taking the traces of water from the glue, which it does with avidity, takes up traces of the glue also, and these traces are slightly greater or less as the alcohol contains more or less water. But this glue and the unavoidable particles of dust, and the unclean air of distilleries, storehouses, etc., dissolved and held by the alcohol are quite sufficient to interfere with so very delicate a test as nitrate

of silver. Most of these are left behind in the distillation, and when the test is applied to the distillate the original impurities of the alcohol are better reached; and this alcohol will always stand the test better after than before distillation. Usually in six to eight hours of diffused daylight it will have passed through a stage of faint opalescence, and will have acquired a very faint brown tinge often noticeable only when compared with the brilliancy of the bottle of distillate which sits beside it. A magnifying glass is required to see the precipitate when the alcohol is very good, and the precipitate is not brown but rather dingy. The writer does not remember any specimen of alcohol thus tested that failed to give some reaction with the test, and the quality was judged entirely by the degree or amount of the reaction, and this test with the test by the smell were always relied upon in practice as being sufficient.

Lately, however, the more rigorous use of the test as directed in the Pharmacopœia has been tried both by the writer's assistant and himself, using the large proportion of nitrate of silver and the direct sunlight, and no specimen of alcohol or spirit yet tried has stood the test. Even the most carefully prepared absolute alcohol, and the cleanest spirit most carefully distilled, are not only rendered faintly opalescent, but have a brown tint and a distinct though very scanty precipitate. In a critical application of the Pharmacopœia method of applying this test made for the purposes of this note, six vials were exposed to the direct sunlight of a day of frequent passing cloudiness. One vial contained distilled water as free from dust and dissolved vapors as possible; another contained carefully prepared absolute alcohol; a third spirit from the barrel; a fourth the same spirit distilled in glass without contact with any organic matter; a fifth a good quality of alcohol from the barrel, and a sixth the same alcohol distilled.

In five minutes' exposure to sunlight the spirit and alcohol from the barrels were quite brown in tint. In an hour the color was at its deepest, and by evening the alcohol and spirit were both transparent and colorless as at first, but a very scanty brown precipitate had separated upon the bottom and sides of the vials. The absolute alcohol showed but little noticeable change for three or four hours, but then a slight opalescence was visible. Later a very faint brownish tint appeared, and by evening a very scanty precipitate had settled out and the liquid was again colorless. The distilled spirit and alcohol gave very similar results, and even the distilled water had lost some of its brilliancy, and had a slight deposit visible with a glass.

A duplicate set of vials exposed only to the diffused daylight of the room on the same day gave similar results excepting in time and degree. At the end of the day the absolute alcohol and distilled spirit and distilled alcohol were of a very faint brownish tint, hardly discoverable excepting when set upon white paper and compared with the distilled water. The spirit and alcohol from the barrels were of a decided brown tint, but without discoverable precipitate. These, therefore, did not stand the test, but the others did stand it fairly well.

If the proportion of nitrate of silver was reduced one-half, and the exposure to direct sunlight omitted, and diffused daylight for three or four hours substituted, the test would be a practical one.

There may be alcohol or spirit which, when re-distilled, will stand the test as directed, but the writer has not met with any, if it be safe to judge by many years' experience with the test less rigorously applied, since there is always a discoverable brown tint from diffused daylight.

The sulphuric acid, the permanganate of potassium and the nitrate of silver are all excellent tests for cleanness in alcohol, but they are each, in a measure, duplicate of the other, since all are directed to organic matter which is easier split by these reagents than the alcohol itself; and they are all confused, and to a certain extent invalidated by the accidental presence in all ordinary alcohol and spirit of a small amount of comparatively harmless organic matter which is unavoidable.

Important as alcohol is in medicine as a solvent and vehicle, and as a material from which so many important agents are derived, it is probably far more important as a therapeutic agent. Derived from the starches and sugars, and a link in the chain of changes by which these elementary foods are utilized by the vital processes, and composed of the same elements only, all reasoning from known data must reach the conclusion that it is a true food, and nutritive in the same way that starches, sugars and fats are, and like them split up and utilized in the economy as a true supporter of life and with the very great advantage of being an absorbable liquid which does not require digestion. The researches of Anstie, Dupré and many others have progressively shown this, and the physicians who see their patients live for days and weeks upon it without emaciation confirm their position. But the millions of gallons consumed annually for a long time past, in the form of malt liquors and wines, by all nations, give such evidence as

cannot be rationally doubted. That it is a stimulant, and a narcotic poison is a circumstance of dose, and of rapidity of absorption, a fact established on evidence no better than that which proves that it is a food. That the abuse of it, and its peculiar action as a poison are justly chargeable with a very large proportion of the vice and crime and misery of mankind is equally well established, but this cannot rationally be permitted to overbalance its uses and proscribe it as altogether evil. The vice, crime and misery are justly chargeable to those who abuse it, and not to the thing abused, and they, and not the agent they abuse, are morally and physically responsible. When drunkenness of any degree is held to be no extenuation of crime, or misconduct of any kind, and when such crime and misconduct are punished with the same certainty and severity as though not committed through drunkenness, the true economic value of alcohol will be better understood, and it will take rank with the starches and sugars, where it belongs, the chief difference being that it is more liable to be abused, and more hurtful when abused.

The effort to shift the responsibility for evil from the individual to the agent which he abuses seems, however, to be only in part misplaced, and hence the benefits derived from discrediting the material abused, and diminishing the opportunities for its abuse. When it is remembered that a large proportion of the wealth of the rich is derived from the luxuries, vices and improvidences of the rest of mankind it will be seen that the responsibility for the means resorted to to cultivate the appetites from which wealth flows should be charged neither upon the agents abused, nor upon those who abuse them, but in large part to those who soberly and deliberately, or who even thoughtlessly, set themselves to work, for money making purposes, to stimulate, extend and increase appetites, habits and fashions by which others are debased, impoverished and ultimately destroyed morally and physically.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. JULY, 1884. No. 4.

ABSOLUTE ALCOHOL.

A correction of some importance is needed for the paper on this subject in the last number of these pamphlets. Near the bottom of page 540 a sentence reads—"But three of the dilutions were made with the 500 gramme flask illustrated at page 353 of a former number of these pamphlets, and are less accurate." This should have read—But three of these dilutions were weighed with the s.g. flask illustrated here at page 529; the remainder being weighed in the flask illustrated at page 353, and therefore are less accurate.

Again, some work was prepared which through accident was omitted altogether, and may be briefly given here.

The coefficient of temperature as ascertained by actual observation, is, for this absolute alcohol, when compared with water at 4° C., ·0008463 for each 1° C. up to 15° C. And between 15° C. and 25° C. it is ·000830 for each 1° C.

Compared with water at 15.6° C., as unity, the coefficient is ·0008266; and these coefficients are only fairly uniform through the dilutions down to about 80 p.c. strength. They then diminish somewhat rapidly, and not regularly—that is to say, not mathematically.

The coefficient deduced from the specific gravities of Mendelejeff for absolute alcohol at this range of temperature is ·0008387. The application of this to his s.g. at 0° C. makes his s.g. at 15° C. ·79367. But the application of the coefficient obtained by the writer, as above given, makes Mendelejeff's s.g. at 15° C. ·79356. So also by his own coefficient his s.g. at 4° C. is ·80290, while by the coefficient of this writer it is ·80286.

Since the publication of the paper in the last number some critical tests for the absence of water not before noticed, have been tried.

The test of Cassoria, of shaking absolute alcohol with white, dried, or anhydrous sulphate of copper, when if water be present the sulphate will be hydrated by it, and turn blue,—is fallacious, although given as being trustworthy by all the authorities examined excepting one. Absolute alcohol of a s.g. of ·7936 at 15.6° C. compared with water at 15.6° C. as unity, when diluted with ·5 p.c. water stands this test. This same dilution also stands the test of forming a perfectly clear solution with all proportions of carbon disulphide and of oil of copaiba. Neither does alcoholic solution of caustic baryta give any reaction. In short, no test has been yet proposed that will detect the water present in alcohol which contains less than about ·1 p.c.

A very recent distillation of absolute alcohol of over 60 gallons, made in hot weather, when the air was full of moisture, and a considerable exposure to the moist air unavoidable, had a s.g. of ·79360 at 15.6° C. compared with water at 15.6° C. as unity. This supports the conclusion that the limit of dehydration, even by lime, has not yet been reached, and in order to be able to examine the subject farther, and with more accuracy, the writer has set up a large percolator containing some 60 pounds of quicklime that was ground, and the finer particles sifted out. It was then put onto a plumbago crucible and subjected to a white heat in a blast furnace during five hours, and transferred to the percolator when cool enough to be handled. Through this lime about 16 litres of the absolute alcohol of the last paper is to be slowly passed and repassed without contact with undried air until the cold weather of next winter, when the writer hopes to return to the subject.

ABSOLUTE ETHER.

The strength of ether, like that of alcohol, is almost entirely judged of, or determined by specific gravity. The other constants of the liquids are the boiling points, but both are so liable to present the appearance of boiling at temperatures both above and below their true boiling points that this constant is not a trustworthy indication of strength for either liquid in practice. Besides, the boiling points present smaller differences than the densities, and are far more difficult to take with accuracy.

The authorities on the subject of ether which is entirely pure, or free from alcohol and water, are nearly as discordant, and as confused as in the case of alcohol, and the differences as great, and therefore the writer's long experience with the substance and his good opportunities for research, have induced him to investigate the substance.

While the admixture of alcohol with water is attended with a rise of temperature which varies with the proportions of the two liquids and gives a varying contraction, thus giving a curve in the line of expansion, and an irregular coefficient,—ether when mixed with alcohol is marked by a fall of temperature and gives a larger coefficient of expansion, which is more uniform. It thus becomes easier to compare the statements of the different authorities in regard to ether, by reducing them to a common temperature.

The following are a few of the prominent authorities upon the density of absolute ether:

Dumas and Boullay, - - -	·713 at 20° C.
Saussure and Thénard, - -	·7155 " 20° C.
Gay-Lussac, - - - -	·7119 " 25° C.
Richter, - - - - -	·706 to ·710 at 20° C.
Boullay, - - - - -	·690 No temperature given.
Kopp, - - - - -	·73658 at 0° C.

These are the six authorities of eleven quoted in Gmelin's Handbook, Cavendish Society edition, Vol. VIII., p. 175,—which give the lowest specific gravities.

Kopp is quoted in "Constants of Nature," Smithsonian Institution, as giving ·73568 at 0°C., but it is doubtful if this be not an accidental transposition of a figure in copying,—Gmelin having the more correct reading for the same s. g.—namely, ·73658.

The Dictionaries of both Watt and Wurtz give ·723 at 12.5° C., the second authority giving this as having been the determination of Gay-Lussac.

Mendelejeff, quoted at second hands, gives ·73644 at 0° C.

The two most recent authorities are Allen,—Commercial Organic Analysis, 1879, Vol. I., p. 134, who gives "0.713 at 15° C., or 0.7185 at 17.5° C.;" and Roscoe and Schorlemmmer,—Treatise on Chemistry, 1882, Vol. III., Part I., p. 333,—"at 0° it possesses a specific gravity of 0.73568, and at 15° of 0.70240.

Each of these more recent authorities gives a pair of specific gravities, and each has a serious error which is apparent to even casual

inspection to such as are familiar with the subject, but which is very confusing to those who are not, and who use the authorities for trustworthy reference.

Allen gives his higher s.g. for his higher temperature, which of course is exactly wrong, since the density diminishes by expansion through increase of temperature. Neither of his specific gravities agree with other authorities, and yet he could not have taken both himself.—at least not from the same ether.

Roscoe and Schorlemmer quote Kopp and Andrews for the boiling point figures in the sentence preceding that for specific gravity, but give the specific gravities, by inference, as being their own. The s.g. at 0°, however, namely, 0.73568, is the one occasionally quoted as that of Kopp, wherein a figure is supposed by this writer to have got transposed, since Gmelin and others quote Kopp as ·73658 at 0°. The second s.g. is, however, wholly incompatible with either of these, since ·73568 at 0° is about equivalent to ·71888 at 15°, while ·73658 is equivalent to ·71978, both seriously at variance with "0.70240."

The writer's determinations for absolute ether, as given farther on, are ·73128 at 4° C. and ·71888 at 15° C.—difference for 11° C. ·01240 ;—or for 1° C. ·00127+. Adopting then the quantity ·00127 as the coefficient of expansion for 1° C., and by it bringing all the authorities above quoted to the uniform temperature of 15° C., they stand very nearly as follows:

Dumas and Boullay's,	·713	at 20°	is equivalent to	·71935 at 15°
Saussure & Thénard,	·7155	" 20°	"	·72185 " 15°
Gay-Lussac,	·7119	" 25°	"	·72460 " 15°
Richter,	·706 to ·710	" 20°	too indefinite for computation, but mentioned because much lower than any other authority met with, with the possible exception of Boullay, who is quoted by Gmelin ·690, but without any temperature given.	

Kopp, as quoted by Gmelin,	·73658	at 0°	is equivalent to	·71753 at 15°
" " others,	·73568	" 0°	"	·71663 " 15°
Watt and Wurtz,	·723	" 12.5°	"	·71982 " 15°
Mendelejeff,	·73644	" 0°	"	·71739 " 15°
Allen,	·7185	" 17.5°	"	·71532 " 15°
"	·713	" 15°	"	·713 " 15°
Roscoe and Schorlemmer,	·73568	" 0°	"	·71663 " 15°
" "	·70240	" 15°	"	·70240 " 15°
The writer's determination	·73128	" 4°	"	·71888 " 15°

The chief difficulties in regard to absolute ether are first, to get it free from alcohol, air and water, and next, to take the s.g. of so volatile a liquid which is so exceedingly sensitive to changes of temperature, with accuracy; and therefore the above discrepancies indicate the means at the disposal of the observers, and the skill and accuracy with which they were applied; and from this consideration it is highly probable that the results of Mendelejeff are the most trustworthy for the present time. With the return of cold weather the writer hopes to resume his investigations, and it is possible then that his own conclusions may be better supported.

The work of all the earlier authorities on absolute ether was rendered very difficult and uncertain for want of indicators of the presence of minute quantities of alcohol and water, so that much of the ether was supposed to be free from these, when in reality it was not so; and although much better indicators are now known and easily applied, it is still doubtful whether these are absolute in their indications, so that all that can be fairly claimed is an important progress toward the desired completeness of result.

The rapidly increasing importance of ether, not only as an anæsthetic in medicine, but as a discriminating general solvent in the arts and sciences, makes it of increasing importance, that its properties should be more certainly and more accurately known, and in this interest the present paper is offered, in the hope that the writer's long experience and excellent opportunities with the substance may enable him to throw some new light upon the subject of its strength and purity, and the means by which those may be definitely ascertained.

In *The American Journal of Pharmacy* for September, 1856, Vol. XXVIII., p. 385, the writer published an article, entitled "Apparatus for the Preparation of Ether by Steam." This was the result of an experience of about three years with various apparatus which led up to this one, and the design there given, with modifications of detail and increase in size and capacity, has now been in constant use for over thirty years, yielding a uniform ether of excellent quality in large quantities. The writer believes that he was the first to use steam heat for the manufacture of ether, or at least the first to publish the fact that the steam from ordinary steam boilers, carrying forty to sixty pounds pressure to the square inch, could be easily utilized for the etherification of alcohol, thereby rendering the process far more safe, easier, more convenient and more economical, and at the same time yielding ether of much better quality.

The modifications of this apparatus, now in successful use, vary very little in design, and not at all in the principles involved from the original as published, although very much larger. The same general form of still and internal steam coil of heavy lead, is followed by a cast iron purifier, the larger lower chamber of which contains a solution of potassa renewed every day. This chamber has a wire gauze diaphragm, always immersed in the solution, to divide the bubbles of vapor, and has a steam coil to keep the solution heated above the boiling point of alcohol, so that the vapors of ether, and of alcohol which has escaped etherification, are finely divided and thoroughly washed in the alkaline solution. Surmounting this chamber are five smaller, plunger chambers of the same form and arrangement as the chambers of an alcohol column. In these the mixed vapors, still kept above their condensing points, are washed five times in succession by a descending current of hot distilled water coming from above. Escaping from this series of washings, the vapors, now consisting chiefly of alcohol and ether, and uncondensable gases, enter a second purifier. This consists of a large block-tin worm which terminates in a central cylinder furnished with wire gauze diaphgrams, upon which rest about two inches of round pebble stones. From the bottom of this cylinder a small block-tin tube leads the liquid condensed by it to a small, cold, condensing worm from which the liquid is conducted to the feed-back of the still, where it is received into the fresh supply of alcohol for the still. At the top the cylinder communicates with the large block-tin condensing worm for the purified ether. The block-tin worm and central cylinder which constitute this second purifier, are placed within a large sheet iron tank supplied with water at a temperature of 35° C. or 95° F., kept at a constant temperature throughout, by means of a long upright shaft supplied throughout its length with propeller blades. This shaft is kept in motion by the power of the current of water which supplies the final large condensing worm.

The still is first charged with about thirteen gallons of alcohol or clean spirit, and into this about two carboys, or 360 lbs. of concentrated sulphuric acid, is run slowly in a small stream. The still is then closed and heated to the etherifying point of about 130° C. or 266° F., the purifiers being charged and heated up at the same time. The temperatures of the various parts being now kept steady the apparatus is nearly automatic. After a portion of ether has been distilled off from the commencing charge, and the temperature of

the contents of the still begin to rise, the supply of fresh alcohol from the feed-back is turned into the still, and so regulated as to keep the mixture nearly at a constant quantity and temperature. The vapors are washed in the first purifier, and then the second purifier, being kept at such a temperature as not to condense the pure ether and the proportion of alcohol which must go with it by the laws which govern the tension of the mixed vapors.—separates all the separable alcohol and other vapors of higher boiling points than ether, and draining these off from the enormously multiplied surfaces of the pebble stones, delivers them into the feed-back to be again subjected to the action of the acid in the still. Thus the separable alcohol which has escaped etherification is returned to the still with the fresh alcohol, until all is etherified ; and the purified ether vapor, with its 4 to 4.2 p.c. of inseparable alcohol, passes over to the final condensing worm, and thence, condensed and cooled, into the storage reservoir. The present apparatus is of such a capacity as to etherify about one barrel of clean spirit each working day of nine and a half hours, and, with the exception of two to three months of summer, when even the well water is not cold enough to give an economical condensation, it is run from year to year. If the spirit or alcohol be of good quality and clean, the sulphuric acid does not require changing oftener than once in each running, and then only because it gets so dark and tarry by the charring of the impurities of the alcohol as to render the mixture in the still liable to frothing. The one charge of acid will generally etherify, without much inconvenience, about 120 barrels of clean spirit, when it becomes economical to throw it away and put in a fresh charge. In splitting the alcohol into ether and water, both distil over, leaving the acid unchanged, except by accidental foreign matters in the spirit—the water accumulating in the lower chamber of the first purifier, to be run off with the solution of potassa at the end of each day. Nothing could be more effective or convenient than this apparatus, either in facility of management or quality of the product, and nothing short of the grossest carelessness or inattention can interfere with the uniformity of the product. First, with the personal attention of the writer, and, afterward, by the services of a succession of intelligent and capable men, it has passed through six different generations or renewals within thirty odd years, without a single serious accident, and always yielding a satisfactory product in the writer's experience. The apparatus has been copied, by the writer's consent, by four other manufacturers, but

without yielding results so satisfactory in quality of product. But in two instances, where it was made for others by the writer's own mechanics, lent for the purpose, the defective quality of product could be traced to the omission of the second purifier, or the substitution of some less expensive and less effective form of this important part.

The apparatus could easily be run night and day, by a double set of hands, if lighted from outside the building, but it is not the least of its merits that it can be stopped over nights and Sundays without serious loss or disadvantage. For the entire process, including the putting up of the product, three good men are required, exclusive of the labelling and wrapping, and of course all who are employed about so volatile and so inflammable a substance must be of a class that renders the services expensive, while the plant itself is an expensive one.

The quantity of alcohol and spirit etherified by the writer with this apparatus now amounts to many thousand barrels, and the strength of the alcohol has perhaps averaged about 91 p.c. The possible theoretical yield of absolute ether from alcohol of this strength is about 4.85 pounds to the gallon, but this apparatus, upon an average of large quantities does not yield over 4 pounds to the gallon. That is, the available product, put up, is about 4.1 pounds of ether of a strength of 95 to 96 p.c. to the gallon. But all packages are put up about 4 p.c. over weight, and there is some loss in bottling and by breakage. So that the net yield of the stronger ether is about 4.26 pounds to the gallon—4.1 pounds, or thereabout, being realized. This ether, as produced for a long time past, has a specific gravity which varies very slightly from the following figures :

Weighed at 4° C.=39.2° F.	comp.	with	water	at	4° C.=39.2° F.	as	unity,	·73662.
" 15° C.=59° F.	"	"	"	"	"	"	·72450.
" 15.6° C.=60° F.	"	"	"	"	"	"	·72384.
" 25° C.=77° F.	"	"	"	"	"	"	71354.

all the specific gravities being apparent or uncorrected.

The ether is quite clean and practically free from everything except alcohol and water. Of this ether about 8 litres was taken and shaken twice in the shaking machine mentioned at page 531, with its own volume of distilled water, for about two hours. The separated ether was then again shaken three times with about one-third its volume of water. By this management about one-third of the ether was washed away, and probably very nearly all the alcohol

was washed out of the remainder, leaving this fully saturated with water. The washed ether was put into two bottles, and to each was added about half a pound of fused chloride of calcium which had been first ground to powder and then re-heated to a point just short of fusion. The bottles were then shaken three times for about 15 minutes at intervals of an hour, and allowed to stand a week with occasional hand agitation, and were then shaken again by the machine as before. This week of digestion and shaking were repeated a third time, after which the clear supernatant ether was aspirated into the distillating apparatus described at page 532 under absolute alcohol. From this it was distilled under a partial vacuum of about 15 inches, by the application of a water-bath with water just warm enough to counteract the cold produced by the rapid evaporation or boiling of the ether. The distillate was received in six fractions. The first and last of these were small fractions, and were not weighed. The four other fractions, of about 750 c.c. each, were very carefully weighed in the flask illustrated at page 529, with the following results, water at 4° C. being taken as unity:

First fraction weighed at				4° C.,	·73128,	uncorrected or apparent.	
"	"	"	"	15° C.,	·71908,	"	"
"	"	"	"	15.6° C.,	·71838,	"	"
"	"	"	"	25° C.,	·70788,	"	"
"	"	compared with water at 15.6° C.=60° F., as unity.					
"	"	weighed at 15.6° C..			·71890,	apparent or uncorrected.	
"	"	"	"	25° C.,	·70842,	"	"
Second fraction, water at 4° C., being taken as unity.							
"	"	weighed at 15° C.,			·71912,	apparent or uncorrected.	
Third fraction		"	"	"	·71916,	"	"
Fourth "		"	"	"	·71928,	"	"

Had this ether been entirely free from alcohol and water it should have had the same specific gravity throughout the distillate. No part of it was, therefore, entirely absolute for reasons similar to these given in regard to alcohol at p. 536.

The first fraction may, however, be accepted as very nearly absolute, or at least as nearly so as any yet obtained by this writer, or as obtainable by water and chloride of calcium in the ordinary way.

Another portion of about five litres of very good ether was well washed with water by hand shaking, and was then digested upon well-burnt quick-lime for four months, with frequent shaking by hand. This was separated from the lime and distilled in the same way as the first portion, but gave a higher specific gravity and a greater difference between the fractions.

Both these portions of nearly absolute ether were separately set aside in well stopped bottles with a fresh portion of recently fused and powdered chloride of calcium to be occasionally shaken by the machine until next winter, when a low temperature may enable the work to be resumed under more favorable conditions, and when a greater length of digestion may establish a better balance between the affinities in the reactions with the chloride of calcium.

It is stated by several good authorities that absolute ether in contact with moisture, or even with moist air, regenerates small proportions of alcohol, and if this be true it materially increases the difficulties of the problem of absolute ether.

The recognition of absolute ether, even by the more recent tests, is by no means easy. The test by admixture with equal volumes of oil of copaiba, or of carbon disulphide, is not at all critical, as the ether obtained by the writer does not show the faintest cloudiness with either of these liquids when previously mixed with ·1 p.c. of watery alcohol.

Fuchsine is stated to be a critical test for alcohol and water in ether. If a very minute quantity of powdered fuchsine be shaken with a considerable quantity of ether, the ether remains colorless if quite free from alcohol and water, but takes a pink tint, the depth of which is proportionate to the alcohol and water present.

In the application of this test it is first necessary to discriminate between the fuchsine of the market. Both acetate and hydrochlorate of rosaniline are sold as fuchsine. The acetate is in large crystalline fragments, while the hydrochlorate is in small nacreous tables, both of a beautiful green color. The acetate is the appropriate salt for this testing. It is, however, not a test for alcohol at all. Increasing proportions of nearly water-free alcohol up to about ·2 p.c. may be added to a nearly water-free ether without increasing the depth of the tint from fuchsine. For water the fuchsine seems to be a very sensitive test indeed, when very carefully applied, but such critical application is attended with some difficulties. The acetate of rosaniline should be used in fine powder. Being somewhat hygroscopic it takes a little moisture from the air in powdering, even if powdered in a warm mortar, quickly, and in a moderately dry air. If the powder has any accidental moisture,—and a little is unavoidable,—this, with its dissolved acetate, will be taken by the ether, even though this latter might have been water-free, and will communicate a tint. Again, if the test tube or flask in which the ether and the acetate be shaken together contain much moist summer air, it

will supply moisture enough to give a tint, or increase that from other sources. The tube or flask should be nearly filled up with the ether, and the depth of tint should be compared with a similar flask or tube similarly filled with the ether without the acetate, and the two should be looked at side by side against white paper. The writer has as yet seen no ether that did not give a perceptible tint under this management, when very closely scrutinized, and this is not remarkable in association with the fact that one milligramme of acetate of rosaniline gives a similar faint tint to ten litres of colorless distilled water. By calculation this would indicate the presence of about ·001 p.c. of water, a proportion almost unavoidably carried to the ether by the acetate and the air in the testing.

Ether which stands this test in this way will bear the addition of nearly ·2 p.c. of absolute alcohol of a s.g. of ·79356 at 15.6° C., compared with water at the same temperature as unity, without distinctly deepening the tint. But if the alcohol added has a higher density the tint will be proportionately deepened by it.

The critical test for alcohol in ether is that of Lieben as modified by Hager. This test is based on the statement that in the presence of iodine and an alkali every trace of alcohol present will be converted into iodoform, which iodoform will separate out in the characteristic form of its yellow crystals. But in order to be very critical this test has to be most carefully guarded, and even then its applicability to ether is doubtful. It cannot be applied directly to the ether for reasons that are obvious. The ether, say 20 c.c. of it, must be well and thorougly shaken with 10 c.c. of distilled water, and the water be separated for the testing. Now if ether in the presence of water regenerates traces of alcohol, as is said on good authority to be the case, it is difficult to see how this water, with which the ether is washed for the testing, can be free from traces of alcohol, even though no alcohol was previously present in the ether. The writer has seen his absolute ether so stand this test as to leave it very doubtful whether a trace of iodoform was or was not formed, after many repetitions, but has never seen it unmistakably absent. The test is best applied as follows:

To the 10 c.c. of washing water 3 or 4 drops of a 10 p.c. solution of caustic potassa are added. Then a solution of iodide of potassium saturated with iodine is added until the solution is rather deeply colored by it. Finally, solution of potassa is again added until the liquid is decolorized. The result is never entirely negative, though at times the precipitate is so scanty as to be hardly per-

ceptible until after the lapse of several hours. The precipitate is then examined with a good glass, when yellow crystals will be found among the particles. With the same materials this test varies considerably from some causes not ascertained, but so far the writer has not failed to find minute microscopic yellow crystals supposed to be iodoform.

It is stated by many authorities that absolute ether is soluble in water in the proportion of one volume in ten of water, but this is a current mistake. Even at a temperature of 25° C. one volume requires 11.1 volumes of water for solution.

When 15 c.c. of the ether and 15 c.c. of water are shaken together at 25° C., there is a contraction of volume to about 29.8 c.c., the ethereal stratum measuring 15 c.c., and the water 14.8 c.c. This ether saturated with water is rendered very decidedly pink in tint by fuchsine.

A prominent object in obtaining absolute ether is that it forms a standard by which to compute with a practical degree of accuracy, the strength of the higher grades of ether which are not absolute, and the ether obtained by the writer, if not entirely absolute is near enough for all practical purposes. By the large apparatus and management described, a very uniform product having an apparent s.g. at 15° C. of ·72450 compared with water at 4° C. is obtained as before stated, and this ether by all the tests proves to consist of about 95.9 p.c. absolute ether, and 4.1 p.c. of alcohol which contains a small proportion of water. The strength of this 4.1 p.c. of alcohol was not accurately determined, but it was estimated to be about 90.75 p.c. corresponding to a s.g. of ·820 at 15° C.

This would give for the composition of such an ether the following formula :

Absolute ether		95.9 p.c.
Absolute alcohol	3.72	
Water	·38	4.1 p.c.
		100.0

This is believed to be sufficiently accurate for all practical purposes, and moreover, it is believed to be about the strength of the alcohol which distills over with the ether for all the strengths of ether which are above 88 p.c. The lower the strength of the ether distilled the lower will be the strength of the alcohol which goes over with it, so that the proportion of water constantly increases from absolute ether to the lowest dilution. This proportion of water increases

very slowly down to the range of about 88 p.c., but then increases more rapidly down to 80 p.c., and more rapidly still down to 70 p.c. The total increase, however, did not appear to be so great as to seriously interfere with the construction of a table which, without any pretensions to scientific accuracy, might still prove to be very useful. Such a table has been constructed and is offered herewith.

The absolute ether actually obtained by the writer is the basis of this table, and the specific gravities were taken by means of the flask illustrated at page 529. For diluting the ether an alcohol was prepared of a s.g. of ·82012 at 15° C., water at 4° C. being taken as unity, or ·82016 at 15.6° C., compared with water at 15.6° C. as unity, such alcohol corresponding very closely to 90.75 p.c. absolute alcohol and 9.25 p.c. water. No attempt was made to reduce the strength of this alcohol for the weaker dilutions,—first, because the rate was not known, though known to be small; and secondly, because the alcohol unavoidably grew weaker as the dilutions and weighings proceeded, by the abstraction of moisture from the summer atmosphere.

From this it may be seen that no such table can be very accurate, and this is the probable reason why such tables have not before been made. But for those who have much to do with ether, a table of even a fair degree of practical accuracy is far better than none at all; and since the number of those who handle and use ether is constantly and rapidly increasing, and will increase more rapidly still as it is more cheaply produced and its uses extend, such tables will become more and more useful.

The dilutions for the table were commenced with the absolute ether of this writer, and carefully adjusted alcohol of ·82016, but from shaking together, and from other exposure to moist air, both the ether and the alcohol of the mixtures became slowly weaker throughout the range of the table, and no attempt was made to prevent this, from considerations mentioned above. Dilutions were made and accurate specific gravities taken for each difference of 2 p.c. down to 88 p.c., and below that for each difference of 4 p.c., all the other specific gravities being supplied by interpolation. And as with alcohol so with ether, two standards of unity are in common use, specific gravities are given by both these standards, —namely, water at 4° C. and at 15.6° C.

ETHER TABLE.

Table of specific gravities of combinations of absolute ether and alcohol ; the ether having a specific gravity of ·71888, and the alcohol of ·82012, both liquids at 15° C. = 59° F. compared with water at 4° C. = 39.2° F. as unity. Or, the ether of ·71890, and the alcohol ·82016, both liquids at 15.6° C. = 60° F., compared with water at 15.6° = 60° F. as unity.

This table is trustworthy to the third decimal place, and moderately accurate to the fourth.

The corrected columns are corrected for the expansion of glass only.

Per cent. by Weight.	Compared with Water at 4° C. = 39.2° F. as Unity.							Compared with Water at 15.6° C. = 60° F. as Unity.		
	Weighed at—							Weighed at—		
	4° C. = 39.2° F.	15° C. = 59° F.		15.6° C. = 60° F.		25° C. = 77° F.		15.6° C. = 60° F.	25° C. = 77° F.	
	True.	Apparent.	Corr'cted.	Apparent.	Corr'cted.	Apparent.	Corr'cted.	True.	Apparent.	Corr'cted.
100	·73128	·71908	·71888	·71838	71817	·70788	·70751	·71890	·70842	·70825
99	·73257	·72040	·72020	·71969	·71948	·70923	·70886	·72021	·70975	·70958
98	·73386	·72172	·72152	·72101	·72080	·71057	·71020	·72152	·71108	·71091
97	·73415	·72205	·72185	·72233	·72212	·71192	·71155	·72284	·71241	·71224
96	·73644	·72438	·72418	·72364	·72343	·71326	·71289	·72416	·71374	·71357
95	·73764	·72564	·72544	·72490	·72469	·71457	·71419	·72541	·71506	·71489
94	·73884	·72690	·72670	·72616	·72595	·71589	·71551	·72666	·71638	·71621
93	·73904	·72814	·72794	·72742	·72721	·71721	·71683	·72792	·71770	·71753
92	·74124	·72938	·72918	·72868	·72847	·71852	·71814	·72918	·71902	·71885
91	·74245	·73064	·73044	·72994	·72973	·71982	·71944	·73043	·72033	·72016
90	·74366	·73190	·73170	·73121	·73100	·72113	·72075	.73168	·72164	·72147
89	·74487	·73215	·73195	·73248	·73227	·72245	·72207	·73298	·72295	·72278
88	·74608	·73440	·73420	·73374	·73353	·72374	·72336	·73428	·72426	·72409
87	·74728	·73557	·73537	·73494	·73473	·72495	·72457	·73547	·72547	·72530
86	·74847	·73674	·73654	·73614	·73593	·72617	·72579	·73666	·72669	·72652
85	·74968	·73791	·73771	·73734	·73713	·72739	·72701	·73785	·72791	72774
84	·75086	·73908	·73888	·73854	·73833	·72860	·72822	·73904	·72912	·72895
83	·75193	·74028	·74008	·73974	·73953	·72982	·72944	·74022	·73034	·73017
82	·75299	·74149	·74129	·74095	·74074	·73103	·73065	·74141	·73156	·73139
81	·75406	·74270	·74250	·74216	·74194	·73224	·73186	·74260	·73278	·73261
80	·75512	·74390	·74370	·74336	·74314	·73346	·73307	·74378	·73400	·73383
79	·75634	·74508	·74488	·74453	·74431	·73469	·73430	·74495	·73523	·73506
78	·75756	·74627	·74606	·74570	·74548	·73592	·73553	·74612	·73645	·73628
77	·75878	·74746	74725	·74687	·74665	·73715	·73676	·74729	·73767	·73750
76	·76000	·74864	·74843	·74804	74782	·73838	·73799	·74846	·73890	·73873
75	·76127	·74991	·74970	·74934	74912	·73970	·73931	·74975	·74022	74005
74	·76255	·75119	·75098	·75063	·75041	·74102	74063	·75104	·74154	·74137
73	·76383	·75247	·75226	·75193	·75171	·74234	·74195	·75233	·74286	·74269
72	·76510	·75374	·75353	·75322	·75300	·74366	·74327	·75362	·74418	·74401
71	·76640	·75504	·75483	·75452	·75430	·74501	·74462	·75492	·74548	·74530
70	·76770	·75634	·75613	·75582	·75560	·74635	·74596	·75623	·74687	·74669

ERYTHROXYLON.

COCA.

The condition of the principal markets of the world for this drug for the past six months has been exceptionally bad. That is, whether good coca was sought for in the ports of Central and South America, or in London, Hamburg or New York, the search, even without limitation in price, was almost invariably unsuccessful. Not that the drug, independent of quality, was scarce, for hundreds of bales were accessible at all times, but the quality was so poor as to be quite unfit for use. The samples, instead of being green and fragrant, were brown and odorless, or musty and disagreeable, at once condemning the lots they represented, to the most casual observation, and yet the price was high enough to have represented a good article. The best that could be done by the most careful buyers, was to accept occasional parcels, the best of which were of very inferior quality, and therefore unfit for medicinal uses, and these at very high prices. Coca is well known to be a very sensitive and perishable drug, only fit for its somewhat equivocal uses when fresh and green, and well cared for in packing and transportation. Very much like tea in this and other respects, it should be packed and transported with the same care and pains, in leaded chests, or in some equivalent package. It is very well known that tea if managed, transported, handled and sold as coca is, would be nearly or quite worthless, and therefore coca managed as the great mass of it is, must be nearly all of it comparatively worthless. If used as tea is, this would probably soon appear, but when used as a medicine which has been highly extolled and well advertised, it seems to go on equally well whether of good or bad quality. It is pretty safe to say that nineteen-twentieths of the coca seen in this market within the past two years must be almost inert and valueless, yet all is sold and used, and its reputation as a therapeutic agent is pretty well kept up. At least many thousands of pounds of the brown ill-smelling leaf, and of preparations made from it are annually sold. And worse than this, considerable quantities of a handsome looking green leaf, well put up and well taken care of, have been sold and used as coca, when wanting in nearly all its characteristics.

The writer for more than a year past has seen but one or two small lots of moderately good coca, and in common with other

buyers has been obliged to buy the best that could be found to keep up his supply of the fluid extract. Almost every purchase has been made on mental protest, and he has been ashamed of every pound of fluid extract sent out, from the knowledge that it was of poor quality; and there seems to be no more prospect of a supply of better quality than there was this time last year, because so long as an inferior quality sells in such enormous quantities at good prices the demands of trade are satisfied.

Under this condition of the markets the writer has finally decided to give up making a fluid extract of coca, and has left it off his list, adopting a fluid extract of tea instead, as a superior substitute, for those who may choose to use it, and regrets that this course was not taken a year ago.

The character of coca as a therapeutic agent is not very good. The florid stories of a multitude of travellers and writers, up to and including the testimony of Dr. Mantegazza, received a considerable support from so good an authority as Sir Robert Christison, who reported very definite results from trials made upon himself, and upon several students under his immediate control and observation; and his results seem to have led to a very careful and exhaustive series of observations at University College, London, by Mr. Dowdeswell. This paper, published in *The Lancet* of April 29th and May 6th, 1876, p.p. 631 and 664, is entitled "The Coca Leaf, Observations on the Properties and Action of the Leaf of the Coca Plant (Erythroxylon Coca), made in the Physiological Laboratory of University College, by G. F. Dowdeswell, B. A." The results of these investigations were absolutely negative, and at the close of the work the investigator says: "Without asserting that it is positively inert, it is concluded from these experiments that its action is so slight as to preclude the idea of its having any value either therapeutically or popularly; and it is the belief of the writer, from observation upon the effect on the pulse, etc., of tea, milk-and-water, and even plain water, hot, tepid and cold, that such things may, at slightly different temperatures, produce a more decided effect than even large doses of coca, if taken at about the temperature of the body."

Conflicting and contradictory testimony from competent authority is not uncommon in therapeutics, and the reasons for it are well recognized in the impossibility of an equality in the conditions and circumstances of the investigations, and hence the general decision commonly reached is upon the principle of averages.

There can hardly be a reasonable doubt that coca, in common with tea and coffee and other similar articles, has a refreshing, recuperative, and sustaining effect upon human beings, and when well cultivated, well cured, and well preserved, so as to reach its uses of good quality and in good condition, it is at least equal to good tea, and available for important therapeutic uses. Mr. Dowdeswell supposed that he used good coca, but it is very easy to see that with any amount of care and pains he may have been mistaken in this. Had he but used the same parcel of coca that Sir Robert Christison did, the results of the two observers would be absolutely incomprehensible; and the results, in the absence of any testimony on that point, simply prove that the two observers were using a different article, though under the same name, and possibly with the same care in selection. On Sir Robert Christison's side of the question there are many competent observers whose testimony is spread over many years; while on Mr. Dowdeswell's side there are fewer observers. But there has been no observer on either side whose researches have been anything like so thorough, so extended or so accurate as those of Mr. Dowdeswell. Indeed, no other account has been met with wherein the modern methods of precision have been applied to the question at all; the other testimony being all rather loose and indefinite, often at second or third hands, or from the narratives of more or less enthusiastic travelers. But if Mr. Dowdeswell's results be accepted as being conclusive, the annual consumption of 40,000,000 of pounds of coca at a cost of 10,000,000 dollars, promotes this substance to take rank among the large economic blunders of the age.*

The testimony in regard to the effects of tea, coffee, Paraguay tea, Guarana and Kola nuts is all of a similar character to that upon coca. Each of these substances seems to have come into use independently, in widely separated countries, to produce the same effects, namely, to refresh, renew or sustain the physical and mental organism, and it was a curious surprise to find, after they had all been thus long used, that although each came from a different natural order of plants, the same active principle,—namely, caffeine could be extracted in different proportions from all. It is now still more curious, however, to find that for centuries another plant, namely, coca, yielding a different principle, has been in use for similar pur-

*An excellent summing up of the character and history of coca, from which some of the writer's information has been obtained, will be found in Medicinal Plants, by Bentley and Trimen, Vol. I., Article 40.

poses, the effects of which differ as little from those of tea, coffee, etc., as these do among themselves. Yet cocaine is chemically very different from caffeine, simply producing a similar physiological effect in much smaller doses. All these substances in their natural condition seem to be identical in their general physiological effect, but idiosyncrasy, or different individual impressibility or sensitiveness, causes a different action, as well in quality as in degree from the different substances, upon some persons.

In order to try to throw a little additional light on the comparative activity of the principal individuals of this group of substances, the following trials were made. It is generally admitted, and is probably true, that the same power in these agents which refreshes, recuperates and sustains in the condition which needs or requires such effects, also counteracts the tendency to sleep,—or produces wakefulness when a tendency to sleep exists, and, therefore, if a tendency or disposition to sleep could be prevented by these agents, this tendency might be used as a measure of their effects when used in varying quantities, and thus measure the agents against each other for dose, or quantitative effect. In this way the proposition is to first measure coca against tea, then coffee against guarana, and finally to compare the four agents, using pure caffeine as a kind of standard to measure by.

An opportunity for such trials occurred in a healthy individual sixty-five years old, not habituated to the use of either tea, coffee, tobacco or any other narcotic substances, of good physical condition and regular habits, and not very susceptible or sensitive to the action of nervines or so-called anti-spasmodics. Quantities of preparations of valerian, asafœtida, compound spirit of ether, etc., which would yield a prompt effect upon many individuals seem to have little or no effect upon him, nor do moderate quantities of wines or spirits stimulate him. That is to say, he has not a very impressible nervous organization, is not imaginative, nor very liable to accept results on insufficient or partial evidence.

Fully occupied with work, both physical and mental in due proportion, for more than ten hours every secular day, when evening comes he finds himself unable to read long on account of a drowsiness supposed to be of a purely physiological character. With a full breakfast at about 7.30, a full dinner at about 2.30, and a light evening meal about 7 ; and no stimulants or tea or coffee at any time, he finds, as a matter of not invariable but general habit, that by half-past 8 drowsiness becomes so dominant that it becomes al-

most impossible, and generally impracticable, to avoid falling asleep in his chair while attempting to read, even though ordinary conversation be carried on around him.

The first trial to combat or prevent this drowsiness was made with caffeine. The first specimen used was a very beautiful article made by Merck of Darmstadt, and after that by pure specimens made for the purpose, the two kinds being found identical in effect.

Commencing with a one grain dose at about 6:30 P.M., on alternate evenings, leaving the intermediate evenings in order to be sure that the nightly tendency still persisted,—and increasing by half a grain each alternate evening, no very definite effect was perceived until the dose reached 2½ grains, and this dose simply rendered the tendency to sleep resistible by effort. After an interval of three evenings with the tendency to sleep recurring with somewhat varying force each evening, a dose of 3 grains was taken,—the maximum single dose of the German Pharmacopiæa. This gave a comfortable evening of restedness, without sleep, or any very strong tendency to it until ten o'clock. Without anything to counteract sleep, the rule was to read with difficulty by nine, without much comprehension by a quarter-past nine, and either be asleep, or go to bed by half-past nine. The 3 grain dose of caffeine repeatedly obviated all this discomfort up to ten o'clock, but did not prevent the habitual, prompt and sound sleep, from the time of going to bed till morning.

This was the model established, upon and by which to measure all the other agents, and they were never taken nearer than on alternate evenings, with occasional longer intervals, especially when the final doses of record were to be taken.

The next agent tried in precisely this same way was coca, and knowing that the quality of that which was attainable was very low, the commencing dose of the leaf in substance was 2 drachms, or about 8 grammes. This gave no very definite effect, but 2½ drachms did give a definite effect, and a subsequent dose of 2½ fluidrachms of a well made fluid extract of coca, gave about the same effect as 2½ grains of caffeine. Three fluidrachms of the fluid extract were about equivalent to 3 grains of caffeine.

Both the coca used and the fluid extract were then assayed by the modern methods, for the proportion of the alkaloid they contained.

The only assays of coca that could be found conveniently were those of Dr. Albert Niemann, of Goslar, given in the *American Journal of Pharmacy*, Vol. XXXIII., p. 122, who obtained

·25 p. c.; and of Prof. Jno. M. Maisch, in the same volume of the same Journal, p. 496, who obtained 4 grains of alkaloid from 1,500 grains of coca, which is also about a quarter of one per cent. These assays were, however, very old, and made by the old process. The process used by the writer was the more modern one of Dragendorff slightly modified. It was as follows:

Thirty grammes of powdered coca, thoroughly mixed in a mortar with eight grammes of caustic magnesia, was stirred into 200 c.c. of boiling water, and the mixture boiled for ten minutes. The liquid was filtered off, and the residue percolated with about 60 c.c. of water. It was then again stirred into 150 c.c. of boiling water, and was again boiled and percolated until apparently thoroughly exhausted. The total liquid, amounting to more than 600 c.c., was evaporated on a water-bath, commencing with the weaker portions, so that the stronger ones might be exposed to the heat for the shortest time—until reduced to about 20 c.c. This liquid extract was transferred to a flask and vigorously shaken with 50 c.c. of strong ether. The ether was poured off, as closely as practicable, into a tared capsule, where it was allowed to evaporate spontaneously. A second and third portion of ether, each of 50 c.c., were used in the same way, and then the whole evaporated to dryness in the capsule. A scanty, greenish, oily residue was left in the capsule, in which there was no appearance of a crystallized alkaloid. The capsule and contents were then weighed and the weight noted. The oily residue was then repeatedly washed with small quantities of water, until the washings no longer affected litmus paper. The oily matter adhered to the capsule during this process, no part of it coming off with the washing, and at the end of the washing the capsule and contents were again dried and weighed, and the weight subtracted from the original weight. The difference was taken as the alkaloid cocaine, and it amounted to ·077 gramme, equal to ·26 p.c.

Several preliminary assays were made in reaching this method. Some authorities recommend the very finely powdered mixture of coca and magnesia, or coca and lime to be at once exhausted with ether. Others recommend that the mixture be made into a paste with water, and after drying on a water bath that it be then exhausted with ether. This is better, but neither of these methods were satisfactory.

Finally, 30 c.c. of a well made fluid extract of the same coca was thoroughly mixed with eight grammes of caustic magnesia in a capsule, and the mixture dried on a water bath and powdered. This

powder was then exhausted,—one part by ether and the other part by chloroform, exactly as in the method given, both parts giving very slightly higher results. As a check upon the results the solution of alkaloid washed out was titrated with normal solution of oxalic acid.

From all this it would appear that this inferior coca of the markets, or rather the best that can be selected from it, yields about the same proportion of the alkaloid as was obtained by Niemann and Maisch, but it has been shown that, by the older processes of assay used by them, much of the alkaloid was probably lost or destroyed, and that much better results are generally obtained by the modern process.

Now, since 3 drachms of this coca, or 3 fluidrachms of its fluid extract gave the same physiological, or perhaps, therapeutical effect, as 3 grains of caffeine, and as the 3 drachms contained about ·45 grain of cocaine, it follows that cocaine is about 6.5 times more effective than caffeine, but it also follows that the coca accessible, and even the very best coca, contains very much less of its alkaloid than those articles which yield caffeine do of that principle.

Having gone thus far with coca which it is proposed to abandon for the present, at least, and to substitute for it a better agent, the next step was to investigate that agent, namely, tea, in the same way.

FLUID EXTRACT OF CAMELLIA.

CHINESE OR JAPANESE TEA.

The generic name of the plant is adopted for the title for the purpose of distinguishing the preparation made for therapeutic purposes from the tea used for domestic purposes, and the title should apply only to a carefully and accurately made preparation, and one made from carefully selected tea which should be of fairly uniform strength as judged by the proportion of caffeine it yields. In going into the tea market to select such a tea the writer was struck with the amount of care and precision applied in all the dealings in tea and coffee. The samples are taken with great accuracy and fidelity, and are so marked that they can always be matched within any reasonable time, and they are compared and judged of with an educated skill that is wonderful. The qualities, varieties and prices are so admirably arranged that any one can get

what he wants, and the largest business is done in an office just large enough to hold the clerks, the books and the samples, the articles as sold being simply withdrawn from the storage warehouse.

If some of this order, accuracy and skill could be carried into the drug market where it is so much more important it would be of great value. And if tea and coffee thus packed, transported, and dealt in in so accurate and so uniform and admirable a way, can be substituted for coca and guarana whose want of care and accuracy are almost the reverse of all this, the interests of medicine will be greatly advanced by the substitution.

In selecting tea for medicinal uses it is easy to avoid those which are loaded and colored, and not at all difficult to get a perfectly natural and good tea, of good original quality, avoiding the high prices which the "fancy" or artificially flavored teas command.

By an easy discrimination, aided by the experts, the writer selected a "basket fired" Japan tea costing 45 cents per pound, as being quite appropriate for medicinal use. Tea contains, according to the authorities, from about ·6 to 4 p.c. of caffeine, and this tea gave by the following easy process of assay 2.87 p.c. of caffeine. The process is a slight modification of that of Dragendorff given in his "Plant Analysis," English translation, 1884, p.p. 62, 186. There is a very great discrepancy among the authorities in regard to the caffeine in tea. Bentley and Trimen, "Medicinal Plants," Vol. I., Article 34, give the range as from 2 to 4 p.c. while others give from 1 to 3 p.c., and it is highly probable that the process of assay used has much to do with the discrepant results. Tried by a good process it must be rare to find an unadulterated tea which will yield less than 1 p.c., and still more rare to find one that will yield 3.5 p.c.

After trying several processes and devices, as recommended by different authorities, on several varieties of tea, the following modification of the process given by Dragendorff was adopted. Of coarsely powdered tea, 10 grammes intimately mixed in a mortar with 2 grammes of caustic magnesia is stirred into about 100 c.c. of boiling distilled water, and boiled for five minutes. The liquid is filtered off, and the residue percolated with 50 c.c. of water. It is then again stirred into 100 c.c. of boiling water, boiled, and again the liquid is filtered off and percolated as before, this time continuing the percolation to exhaustion. The liquid amounting to about 360 c.c. in all, is evaporated on a water-bath

to about 20 c.c., evaporating the weaker portions first so that the stronger may be subjected to heat the shortest time. The liquid extract is then transferred to a vial or flask, which it does not more than one-fourth fill, 25 c.c. of chloroform is added, and the mixture vigorously shaken for five minutes or more. It is then transferred to a separating funnel, where the liquids are allowed to separate, when the lower chloroform solution is drawn off into a tared capsule. The residue is then returned to the vial, 25 c.c. more of chloroform added, and the shaking and separating is repeated as before. A third washing with chloroform is only needed when great accuracy is aimed at, since usually the chloroform of this washing if evaporated separately does not yield over ·05 p.c. of caffeine. The separation of the chloroform solution, before it can be drawn off, commonly requires three or four hours, and if the capsule with the first portion be set in a warm place the chloroform will have nearly all evaporated off before the next portion is ready to be drawn into the capsule. When the last portion is in, the evaporation is carried to dryness. The caffeine is left in a very nearly white and pure condition, and for all practical purposes may be weighed just as it is left by the chloroform. If a closer and more accurate weighing be required, it is dissolved by gentle agitation in the capsule in successive small quantities of distilled water, this solution filtered into another tared capsule, and this set in a warm place for spontaneous evaporation to dryness. A bed of very white and pure crystals is thus obtained and a very small amount of slightly colored fatty matter is left behind.

Several varieties of very good tea were examined by this process, and one sample of Oolong tea, costing sixty-nine cents per pound, was found to contain 3.12 p.c. of caffeine. The others varied between 2.2 and 2.8 p.c., that bought for making the fluid extract yielding by duplicate trials 2.86 and 2.88 p.c.—mean 2.87 p.c.

The selection of a menstruum with which to exhaust the tea in making the fluid extract was a matter of much importance. The solvent should be such as to extract and hold all the useful constituents of the tea. It is easily seen that the caffeine does not wholly nor fully represent the tea, and also that the condition of this substance in the tea in its natural combinations is much more active than when it is separated out, as will be fully shown farther on. Therefore the tea should be extracted without any chemistry, or any breaking up of its natural molecular construction, and by a simple neutral solvent. Beside this the fluid extract should be as

nearly as possible soluble in water, and should contain the least practical proportion of alcohol, and should keep unchanged for an indefinite length of time, always in readiness for use. After many trials too prolix for relation, although a detail of them might save others from fruitlessly going over the same ground, a very good menstruum was found in a mixture of 20 parts by weight of alcohol, 5 parts glycerin, and 75 parts water, and the following formula and process by repercolation were finally settled upon.

Take of Tea, coarsely powdered, 2,000 grammes or 64 troyounces.
Alcohol,
Glycerin, and
Water, of each a sufficient quantity.

Mix by weight 20 parts of alcohol, 5 parts of glycerin, and 75 parts of water, and shake the mixture well, for a menstruum.

Moisten 500 grammes or 16 troyounces of the powder thoroughly with about one-tenth of its weight of the menstruum, allow it to stand in a closely covered vessel for about 12 hours, and having packed it loosely in a cylindrical percolator pour menstruum on top and percolate until the tea is exhausted, the exhaustion being complete when the percolate may have very nearly the same weight for a given volume, as the menstruum.

Reserve the first 190 c.c. or 6.5 fluidounces of percolate that passes, and receive the remainder of the percolate in fractions of about 240 c.c., or 8 fluidounces each, numbering these fractions of the weak percolate from No. 1 to the end of exhaustion.

Moisten a second portion of 500 grammes or 16 troyounces of the coarsely powdered tea with about one-tenth of its weight of the weak percolate No. 1, allow it to stand, pack it and percolate it exactly as the first portion was managed, only that the fractions of weak percolate are used, in their numerical order, to be poured on top instead of new menstruum, and allowing each fraction to sink into the powder before the next is poured on. When all the fractions have been thus used, pour on new menstruum to complete the exhaustion as in the first portion.

Reserve the first 380 c.c. or 13 fluidounces of percolate and add it to that reserved from the first portion, and receive the remainder of the percolate in fractions of about 240 c.c., or 8 fluidounces each, numbering these fractions as before.

Moisten a third and a fourth portions of 500 grammes each of the tea, in succession, and treat each of them and percolate them in exactly the same way as the second portion.

Reserve the first 475 c.c. or 16 fluidounces of percolate from each of these portions and add it to that reserved from the first and second portions, and receive the remainder of the percolates in fractions as before.

There will now be in the bottle containing the reserved portions (190+380+475+475=) 1,520 c.c., or 51.5 fluidounces of reserved percolate, and this is the finished fluid extract which pretty accurately represents the tea in the proportion of 95 c.c. to every 100 grammes, or minim for grain.

The fractions of weak percolate from the fourth portion are put away until the stock of the fluid extract needs to be replenished, and they are then used exactly as the third set of fractions was used on the fourth portion; and this management is continued and repeated to any number of portions through any number of years, reserving now the 475 c.c. or 16 fluidounces from each portion, as finished fluid extract.

It is easy to see that the first making, namely, the 1,520 c.c. of fluid extract, may not be critically accurate in representing the tea in the exact proportion of minim for grain, but it is sufficiently accurate for all practical purposes; and it is equally evident and mathematically demonstrable that, if not accurate, the process will become more so, with each successive repetition, forever.

The great advantages of this process of repercolation are easily seen in an article like tea, where some of its qualities are very delicate and sensitive, and easily destroyed, and hence where it is of the first importance that all the properties should be extracted and preserved in their natural condition. Any heating process would, to the extent to which the heat was used, injure tea, coffee, coca, guarana, etc., and the writer believes would, or does, injure all medicinal organic substances.

The Fluid Extract of Camellia, so made, is an almost syrupy, transparent liquid of a rich, dark, olive green color, almost black, with a fragrant odor of the tea and its agreeable bitter taste. It has an apparent s.g of about 1.095 weighed at 15° C.=59° F., compared with water at maximum density, as unity, while the menstruum, by the same standard, at the same temperature, has a s.g. of ·982. When mixed with water, syrup, or wine,—the three vehicles which will be most appropriate to its use for both adults and children,—it makes a somewhat opaque mixture, which is unsightly, but nothing settles out. Diluted with its own menstruum, the mixture is, of course, perfectly transparent.

This fluid extract, of course, contains the same proportion of caffeine as the tea from which it is made. In this case, that proportion being 2.87 p.c., each fluidrachm of the fluid extract would yield, by careful assay, 1.72 grains of caffeine, and 105 minims, or 1.75 fluidrachms would yield 3 grains of caffeine.

This fluid extract, when tried physiologically upon the same person, and in precisely the same way that caffeine and coca had been tried, commencing with 30 minims and increasing until the effect was reached, was found to be equally effective in the dose of 70 minims. That is, 70 minims of this fluid extract gave, upon these trials, the same comfortable restedness and the same wakefulness until 10 o'clock, and permitted the same promptitude and soundness of sleep after 10 o'clock, that was obtained from 3 fluidrachms or 180 minims of the fluid extract of coca, or from 3 grains of caffeine.

This 70 minims of the fluid extract, equal to 70 grains of the tea, yields only 2.01 grains of caffeine, and from this the first notable fact is that about 2 grains of caffeine in tea, in its natural condition, is equivalent in effect to 3 grains of caffeine extracted from the tea, and used as caffeine. This would be more remarkable if it was not so general as to be the rule with separated active principles. Next, it is noticeable that 70 minims of this fluid extract of tea is equivalent in this effect to twice and a half times that quantity of a fluid extract of the best accessible coca. Now, of course, it is not proven that equivalency in this single effect of overcoming drowsiness, makes it generally equivalent to coca for medicinal uses, but when the subject is considered in all its bearings, it certainly establishes a strong probability that this effect is a good measure of its total medicinal activity.

If this be provisionally admitted it would follow that under whatever conditions coca had proved to be useful, tea would be found equally so in much smaller quantity.

Coca for centuries was in popular domestic use for the same purposes and effects as tea, before it was introduced to use as a medicine. Then why should not tea be introduced to use as a medicine as a substitute for coca when the one can always be had of uniform good quality while the other cannot;—when the effects are probably identical, and when the quantity of tea necessary to produce the effect is so much smaller, and finally when the cost of tea is uniform and generally from one-half to one-third that of the variable coca:—and when, if the quantity of each required to produce a given effect be

taken into account, the cost of the effect by coca is about 5 times as great as by tea.

It is then highly probable that whatever therapeutic effects may have been actually realized from coca, will be better attained from tea. Then, it may be asked, why not be satisfied with tea in its universal domestic position, and let the physician simply order a cup of tea, when he may need its effects? The answer to this is that he will, of course, do so whenever the effect of a cup of tea is all that he wants. But the same reasons for taking coca from the domestic economy of the Peruvians, and introducing it into the materia medica in definite form, are equally good for tea, and are almost self-evident in both. In Peru and Central America coca is chewed in an indefinite, irregular and rude way, not at all adapted to therapeutics. In most civilized nations tea is drank in the same indefinite way, and of various qualities and strengths.

In making the infusion for domestic use the common rule is a teaspoonful of tea for each person and an additional one for the pot, and as many cups of boiling water as there are persons to be served. This is all much too loose for therapeutic usage, even if that usage be only the simple restorative effects of single doses in conditions of debility and exhaustion. By actual trial the amount of tea taken by housewives for a cup of tea varies all the way between 50 and 70 grains, and the tea is not exhausted in the domestic process within 10 or 15 p.c. of its strength. Then again if tea is to be used as coca is, as an auxiliary in the treatment of the opium habit and the alcohol habit, and in protracted debility, whether during disease or convalescence, it is required in uniform doses at stated times, or in other words the quantities and repetitions are of quite as much importance as the agent itself, because it is quite as much in the management of his remedies as in the remedies themselves that the skill of the more successful physician consists.

Again, the indications for this class of remedies is often plain to the observant physician in some conditions of children where it is important that the dose should be small as well as uniform, and it is in children and persons not habituated to the use of tea and coffee that this class of agents are most potent for good. It has long been known that coca and guarana had but little effect, upon those who were habitual users of tea and coffee, unless given in very large doses, and that the doses had to be large in proportion to the quantity of tea and coffee consumed. This is, in a measure, equivalent to the circumstance that if the tea or coffee in such cases could be defi-

nitely and accurately increased for the special temporary condition needing or requiring it, the coca or guarana would be unnecessary.

From all this, it may be stated as being at least highly probable, that whenever coca or its fluid extract are indicated in therapeutics, tea or its fluid extract will be found to be a superior substitute, in doses of a little over one-third the quantity. The doses must, in all cases, be carefully adjusted to the widely differing susceptibility of different individuals. A fluidrachm of this Fluid Extract of Camellia will probably be found to be an average adult single dose as a restorative. But for repetition throughout the twenty-four hours, or more, it would doubtless be too large, and would produce morbid vigilance.

In narcotic poisoning, or when it becomes necessary to interfere with or control accidental narcotism from any cause, three or four fluidrachms, or even more, may, and should be used, proportioning the dose to the condition which is to be counteracted.

GUARANA.

This substance is a rude heterogeneous mixture. Neither the ingredients nor their proportions have ever been known with any useful degree of accuracy, and it is only known that they vary largely, not only from time to time, but in different rolls of every single package ever met with in the markets; and, probably, one reason why the composition has never been known is that it is not constant.

It is made in the country of the Guaranis, a large tribe of half savage South American Indians; and it is highly probable that different parts of the tribe make it in different ways. From the known habits of such people, and the traditions of how they make all such mixtures as this, it is hardly probable that it can be even roughly accurate to any formula, or that it can be either cleanly or wholesome; and, certainly, any one who investigates it much, as the writer has of late done, will get odors and reactions that will remind him of what he has read of the medicaments of savages, both of ancient and modern times. The Guaranis seem to have been cunning enough to have kept their secret of this mixture very well. Thirty years ago, when the writer was in Brazil, guarana was met with chiefly made rudely into the forms of ducks, lizards, and other

things familiar to the Guaranis. It was not then much used, and the texture was very different from what it now is, being more homogeneous, and more resembling cocoa or chocolate in appearance, taste and odor. It has always been said to consist largely of the seed of *Paullinia sorbilis*, and fragments of this seed have been identified in the pieces, but there are evidently many other ingredients, while the mass consists largely of starch.

How such a substance can ever have been so largely accepted in the materia medica, can hardly be accounted for on any other basis than that of fashion. It had only been a very short time in use, on the statements of travellers and enthusiasts, when it was found to contain a large proportion of caffeine, and this caffeine was traced to the seeds of *Paullinia*, and these were, doubtless justly supposed to be the active medicinal agent. As a natural result of this, an effort was made to get the seeds for use, so as to be able to discard the guarana. But throughout many years past the efforts to get these seeds in any larger quantity than small sample parcels, have been fruitless. The writer and others have repeatedly sent out orders without limitation of price, both directly to native houses, and through large importers, but the universal reply was that those who collected them would not sell them. The inference is that they made more money on them by using them as an ingredient in guarana, and that they were astute enough to see that if they sold the seed the demand for guarana would soon fall off; and this inference is the chief if not the only indication that they are the principal, if not the only ingredient of value in guarana. The time will probably come when these seeds will be obtainable, and as they contain much more caffeine than any other ordinary source of this principle, they will be a valuable acquisition to the materia medica. If there should occur any possibility of monopolizing them, even for a moderate length of time, some enterprising, money-making firm may be depended on to take advantage of it.

Some three years ago guarana was in great abundance in all of the principal drug markets of the world, but especially plentiful in large quantities in London and New York, and the price ran down to about 65 cents per pound,—a price that some would be glad to pay for *Paullinia* seed. It is true that the quality was generally very low, and gave evidence that the stuff was half mixed, and hurried into the markets by every means possible. The enormous stock was, however, soon all taken up under the stimulus of the low prices, and the preparations were advertised and pushed into

use, so as to start a fashion which has not yet died out. During the past year the drug has become increasingly scarce and dear, until it now sells, as fast as it can be obtained, at about $3.50 per pound by the package in first hands, and for any proper use of it at least one-fourth of the rolls have to be rejected. This makes it so very dear in proportion to its real therapeutic value that it seems now high time to reject it, and look for a substitute, especially in consideration of the fact that as an heterogeneous mixture of unknown composition, secretly made by half savages, it never should have been accepted. The scarcity of it now is reported to be in consequence of its having become fashionable as the basis of a drink, probably fermented, among some half civilized South American races.

Its principal use in medicine has been in the form of a fluid extract, and within the past ten years the writer has had a constantly increasing demand for it up to the present time; but, from the considerations above mentioned, he abandons it altogether and dismisses it from his list, substituting for it a fluid extract of green or unroasted coffee, for any who may desire a substitute.

As caffeine has always been the generally recognized active principle of guarana, it was important to know how much caffeine it contained; therefore, a good specimen of guarana and the fluid extract of well selected guarana were both assayed by the following process,—the process being adopted after many trials of other processes which were less successful in the writer's hands.

Ten grammes of powdered guarana and two grammes of caustic magnesia are mixed with 100 c.c. of water, and the mixture boiled for 5 minutes, the result being a consistent paste from the amount of starch present. Add to this paste while hot 50 c.c. of strong alcohol, stir thoroughly, and having transferred the whole to a filter drain off the liquid and percolate the residue with a mixture of 60 c.c. of water and 40 of alcohol. Boil the residue a second time with 100 c.c. of the same mixture of alcohol and water, and again drain and percolate it until exhausted, or until the total liquid amounts to 300 or 350 c.c. Evaporate this on a water-bath to about 20 c.c., and transfer it to a vial or flask, rinsing the last portions in with a little water. Add to it 25 c.c. of chloroform, agitate the mixture vigorously, allow it to separate and draw off the chloroform solution into a tared capsule. This separation of the liquids is best effected by shaking them in a separating flask of a conical shape furnished with a stop-cock at the lower, small extremity, but

if such a thing be not at hand, the separation can be conveniently effected by having a duplicate cork for the flask or vial in which the shaking is done. This cork is perforated with two small glass tubes, one of which reaches nearly to the bottom of the flask, and projects about half an inch through the cork outside,—and the other passes just through the cork and projects about an inch outside. Both tubes are stopped outside, preferably by short pieces of rubber tubing and pinchcocks. Thus arranged, and the liquids having been allowed time to separate perfectly, the mounted cork is put in the place of the one used during the shaking, and the flask is gently inverted and placed in a convenient holder or stand. Allowing a few moments for the re-settlement of the liquids, the tared capsule is placed under the exit tube, and the rubber tube is dexterously slipped off without the loss of any of the chloroform solution. Then by loosening the pinchcock on the tube for the admission of air, and compressing the rubber tubing with the finger and thumb, air may be gently admitted until all the chloroform solution has run into the capsule. The flask is then turned up,—the corks exchanged,—25 c.c. more chloroform added, and the shaking and separation repeated. This chloroform washing is repeated a third time, and if great accuracy be desired, a fourth time. The chloroform solution is then evaporated to dryness, when it leaves the caffeine white and nearly pure. In one assay the four chloroform washings were evaporated in separate tared capsules, and gave respectively ·440, ·037, ·005 and ·001 gramme. Total ·483 gramme, equal to 4.83 p.c. of caffeine. If further purification of the caffeine be desired, it may be done in the way mentioned in the assay of tea.

It is generally stated by authorities that guarana yields 5 p.c. of caffeine, and it is possible that some pieces might be selected that would yield this proportion, but the figures just given were from a select piece; and the fluid extract, although made from selected pieces from which perhaps one-fourth of that of a good commercial quality had been rejected, gave on assay, only 4.3 p.c. The best parcels as found in the market, if powdered and used without selection, would probably give a preparation yielding less than 4 p.c.

Although the individual trying these substances physiologically is not fastidious, it required a good deal of courage to swallow preparations of such a mixture as guarana; nevertheless it was carefully tried, and it was found to require just about a fluidrachm to give the effect of 3 grains of caffeine,—3 drachms of coca, or 70 grains of tea. Now a fluidrachm of a fluid extract containing 4.3

p.c. caffeine would contain 2.58 grains of caffeine, so that 2.58 grains of caffeine in its natural condition in guarana,—if it be in its natural condition there,—is equivalent in effect to 3 grains of extracted and purified caffeine artificially prepared.

In abandoning this substance the writer proposes to substitute for it a fluid extract of green or unroasted coffee.

FLUID EXTRACT OF GREEN COFFEE.

What has been said in regard to tea applies equally, in a general way, to coffee, and need not be repeated. It can always be easily obtained of excellent quality, at moderate and uniform prices proportionate to the quality, and, yielding the same physiological effect as guarana, it is fair to infer that it may be well adapted to the same therapeutic uses. Caffeine, though it does not represent the full power or activity of any of these agents which yield it as their active principle, is still a very useful measure of their activity. That is, they appear to be active nearly in proportion to the amount of caffeine they yield on assay. While they all give a far better,—and perhaps a different effect from the caffeine obtained from them, yet those which yield the most caffeine are required in the smallest doses to yield their own peculiar effect, however different that may be from the effect of pure caffeine.

Good authorities differ very much in regard to the proportion of caffeine in coffee. Bentley and Trimen, Medicinal Plants, Vol. II., Article 144, say that coffee contains from ·75 to 1 p.c. of caffeine. Dragendorff, as quoted in Wood and Bache's United States Dispensatory, latest edition, p. 310,—examined 25 specimens of coffee of different kinds, and found a variation of from ·6 to 2.2 p.c. of caffeine ; the latter proportion, however, was only found in a single specimen called Gray Java, none of the other varities reaching 2 p.c.

The writer in selecting a coffee for this fluid extract, by the aid of the experts, took a Java coffee which was represented to be the same in quality as that formerly known as "Old Government Java."

The coffee was assayed by exactly the same process as that above described for the assay of tea, and the process answered very well until the chloroform was applied, when the albuminous matter of

the coffee gelatinized with the chloroform, and no separation could be had. Ether was tried instead of chloroform, but with the same result, and when the ether was added, a little at a time, until the quantity was large, a transparent syrupy liquid was obtained that seemed entirely homogeneous. Finally the difficulty was surmounted by the device of precipitating out the pectin-like matter by means of alcohol.

When the infusion had been evaporated down to about 20 c.c., 60 c.c. of alcohol was added and the whole well stirred. The precipitate was filtered out and well washed with a mixture of alcohol and water 3 to 1, and the alcoholic solution evaporated to 20 c.c. This was then washed with chloroform exactly as in the assays of tea and guarana, except that only two washings were required. Three washings were made in one assay, and evaporated in separate capsules. They gave ·117, ·013, and ·000 gramme. Total ·130 gramme equal to 1.3 p.c. of caffeine from the coffee.

This Fluid Extract of Green Coffee was finally made with exactly the same menstruum, by repercolation in exactly the same way so fully detailed under the head of Fluid Extract of Tea, only that it was found better to powder the coffee until it all passed through a No. 60 sieve, and moisten the powder with double the quantity of liquid used with tea, and pack it more firmly in the percolator. The process was then very successful, yielding a more fluid preparation than that from tea, and of a more dingy olive green color. The mawkish smell and taste of raw coffee were very pronounced, and though less agreeable than those of tea, were not disagreeable. The s.g. is 1.096 at 15° C. = 59° F., that of the menstruum being ·982 at the same temperature, water at 4° C. = 39.2° F. being taken as unity.

This preparation, when tried physiologically in exactly the same way as the other agents were, was found to be just about half the activity of tea. In three trials, two with 140 and one with 150 minims, the results were not distinguishable from those of 70 minims of the preparation of tea. Now the amount of caffeine in 140 minims of this fluid extract is 1.82 grains, and in 150 minims 1.95 grains, so that 1.95 grains of caffeine in its natural condition in coffee is equivalent to 3 grains of the pure caffeine extracted by the chemist, and is equivalent to about 2 grains of caffeine as it exists in tea, and about 2.58 grains as it exists in guarana.

This fluid extract of coffee in the presence of that of tea would seem to be a mere dilute and inferior duplicate, of which there are

far too many in the materia medica already, and the only reason for its being offered is that the general testimony is very strong throughout all the authorities that there are a considerable number of persons who in health are very differently affected by tea and coffee. There are many persons who cannot,—or who believe they cannot,—take the one without harm, and yet can take the other with benefit; and a still larger number who can take both, but with much better effects from one than the other. If this be true in health it is likely to be emphasized in diseased conditions, and hence the possible or probable utility of the two preparations, although to the generality of mankind the effects of either might be equally acceptable. Where this is the case of course the preparation of tea is to be preferred. How much quantity or doses, and time of taking them, may have to do with the headaches, palpitations, morbid vigilance, dyspepsia, etc., attributed to each by those who can take the other with benefit, and how much may be purely imaginary, it is impossible to tell, but as long as such beliefs are very firmly fixed, and not uncommon, it may be well to have the two preparations, although they are for exactly the same purposes.

The method of comparing these agents by a physiological test is not offered as a method of precision, or as worthy of any great trust, and it is especially guarded against being received for more than it is really worth. It is only a practical plan, carried out with much pains and care, for close guessing at results. But the observations made are fairly consistent among themselves, and therefore place the agents in a true relation to each other. Any other person under as good or more favorable conditions, might, apart from idiosyncrasy, get different results, but they would probably be in the same, or in better accord among themselves. The only very definite point made is the very wide difference in the activity of caffeine in its natural and its artificial conditions, and of this there can be no doubt.

The deduced equivalency in effect, presented in one view, is as follows:

Of artificial caffeine 3 grains is equivalent to 180 grains of coca, which contains about ·45 grain of cocaine;—and to 70 grains of tea, containing 2 grains of caffeine;—and to 60 grains of guarana, containing 2.6 grains of caffeine;—and to 150 grains of coffee, containing 1.95 grains of caffeine. This would make the amount of caffeine in the coffee a little the most active of all, since a smaller quantity produced an equal effect. But it is so near to the tea

that they may be considered identical; while the caffeine in the guarana appears to be the weakest, and to approach most nearly to the artificially extracted caffeine. Besides this, it was rather indistinctly and indefinitely perceived throughout the alternations of the trials that, in the effects of all four of the agents, there was something superadded to the effect from the caffeine. To say that their effects were better is very indefinite, yet it is about all that can be said. Perhaps it will qualify this opinion or judgment to say that the effects seemed broader or more general, or more comprehensive. They certainly were more agreeable, and gave a better sense of rest and well-being. When these agents may be given to more sensitive and more delicate organizations, impressible by smaller quantities, as in women and children who are in conditions to need them medicinally, then slighter differences will doubtless become more prominent and more important. It must always be borne in mind that the doses here used might be heroic, and not entirely harmless in delicate, impressible persons or conditions sensitive to this class of agents; and that, as in medicines generally, each individual and condition is a law unto itself, and has its appropriate dose only to be ascertained by trial, the doses of the books being merely useful guides to commence by. These considerations of dose and effect are very important in a class of agents like these, which, though practically the same, are supposed to have such different effects upon different persons, because it is quite within the limits of probability that the differences are merely differences of effect of arbitrary dose or quantity upon varying susceptibility. That is to say, a person on whom a cup of coffee would give a wakeful, restless, uncomfortable night, with headache, while a cup of tea would be only agreeable and beneficial, is apt to forget that a cup of black coffee represents more than twice as much caffeine strength as a cup of tea, or is more than double the dose, and does not stop to try what two and a half cups of tea, or half a cup of coffee would do, before condemning the coffee as never agreeing with him, while tea always did.

THE PHARMACOPŒIA OF 1880.

(Review Continued.)

ÆTHER FORTIOR.

STRONGER ETHER.

A liquid composed of about 94 per cent. of Ethyl Oxide [$(C_2H_5)_2O$; 74.— C_4H_5O; 37] and about 6 per cent. of alcohol containing a little water. Sp. gr. not higher than 0.725 at 15° C. (59° F.), or 0.716 at 25° C. (77° F.).

Stronger ether should be preserved in well-stopped bottles or in soldered tins, in a cool place, remote from lights and fire.

A thin and very diffusive, clear, and colorless liquid, of a refreshing, characteristic odor, a burning and sweetish taste, with a slightly bitter after-taste, and a neutral reaction. It is soluble, in all proportions, in alcohol, chloroform, benzol, benzin, fixed, and volatile oils, and dissolves in 8 times its volume of water at 15° C. (59° F.). It boils at 37° C. (98.6° F.). Ether is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently.

If a piece of pale blue litmus paper moistened with water be immersed ten minutes in a portion of the ether, the color should not change. On evaporating at least 50 C.c. in a glass vessel, no fixed residue should appear, and, on evaporating a portion dropped upon blotting paper, no foreign odor should be developed. When 10 C.c. are agitated with an equal volume of glycerin in a graduated test-tube, the ether layer, when fully separated, should not measure less than 8.6. C.c. It should boil actively, in a test-tube half filled with it and held a short time in the hand, on the addition of small pieces of broken glass.

Preparations: Spiritus Ætheris. Spiritus Ætheris Compositus.

The name Ether Fortior, or Stronger Ether, is now perhaps no longer necessary, and it would have been a considerable advance in the right direction if the Committee had abandoned the old dilute ether, and transferred the simple name ether to this preparation. In relation to this article it is very curious that the old bad name "Sulphuric Ether" is still not uncommon even among those who ought to know better. There are many names which it does not seem to do much good to try to correct.

The above description and tests of this very important substance are in the main very full and satisfactory, and were all in accordance with very good authorities at the time they were adopted. But as has been shown, under absolute ether, good authorities are not in accord upon some points, and upon these the Committee of Revision happened to copy some errors, which, had they examined the points for themselves, they would have detected and corrected by their high authority.

In the first place, this Stronger Ether, when of a s.g. not higher than ·725 at 15° C. compared with water at 4° C. is composed of not less than 95.9 p.c. Ethyl Oxide and 4.1 p.c. of alcohol containing a little water, instead of 94 p.c. and 6 p.c., and this when the apparent s.g. is ·725. A good specimen, carefully weighed, gave an apparent s.g. of ·7245 at 15° C., which corresponds to very nearly 96 p.c. (see table given under Absolute Ether). When specific gravities are given to the third decimal place only, it does not matter very much whether they be apparent or true, since the corrections seldom affect the third decimal, but in a light liquid like this it would be better to state only apparent specific gravities and give them to the fourth decimal place, since this is needed to keep the third figure accurate to within a half per cent. The second specific gravity given is erroneous, because that which at 25° C.= 77° F. corresponds to ·725 at 15° C.=59° F. is ·714, not ·716, as given.

Well-stopped bottles do not retain this ether well, even in a cool place. Such a place always smells distinctly of ether; and by accurately weighing a tray containing 50 one-pound bottles well stoppered so as not to leak perceptibly when laid on their sides for any length of time,—they were found to lose at the rate of about 2 ounces per month during a year. With this rate of loss, when standing erect and perfectly still, in a cool place, it may be inferred that in ordinary handling and transportation the loss is far greater, and although such bottles are always put up by the writer containing 3 to 4 p.c. over weight, they are doubtless short in weight after a transportation of more than 200 miles. Again, a leaky stopper can never be detected unless the liquid escapes at a rate faster than it can evaporate. This with so volatile a liquid as ether is hardly possible, and it presents a serious difficulty, because in grinding stoppers on a large scale, even without regard to cost, it is impossible to get workmen who will make every bottle tight. Indeed, an entirely tight stopper is a very rare thing, and requires a very high order of skill and much time and labor. A slightly imperfect stopper that will show no signs of leakage when laid upon its side over night and give no smell of ether around the stopper that can be easily detected in a room containing ether vapor, may still leak at a rate that will partly or entirely empty it during transportation, and this without giving the slightest evidence upon the tying over or wrapping of the bottle. When this occurs in the writer's experience, as it does occasionally, he is very apt to get a more or less fierce

letter accusing him of putting up short weights or empty bottles. Corks do not secure ether any better, nor as well as glass stoppers for transportation, because if the either be of full strength, the cork rapidly shrinks and becomes too small for the bottle. The ether seems to dissolve out a considerable amount of matter from the cork and then will not stand the test of leaving no residue on evaporation,—besides, it absorbs all the water from the cork, and this is the main cause of the shrinkage. Nothing can be better than a cork for temporary use in an ether bottle, but it does not answer well for long storage or for transportation.

Glass is not a good material for holding ether, because it is so fragile and so liable to accidents, and ether when spilled is so dangerously inflammable. The writer has seen ether take fire at a measured distance of fifteen feet between the source of the escaping vapor and the source of the fire, and many times has seen it take fire at shorter distances between a broken bottle and a gas light. In his experience of thirty years he can recall five disastrous fires, involving many lives and serious injuries, and over a million of dollars of property, which were directly traced to the breaking of bottles of ether. So well known is the danger from ether in glass that the danger is greatly exaggerated in some directions. For example, there are very few transportation companies that will carry a box which is marked "Ether" on the outside, while in strict propriety no amount of ether exceeding a pound or two should ever be packed in glass, on any order for ordinary transportation, without the package being marked "Ether" on the outside. But to so mark a box is simply to prevent the sending of it by a large majority of the transportation lines, and deprive large sections of country from the possibility of ever getting any ether. As a matter of fact, and almost of necessity, ether is largely transported in glass without being marked, and yet accidents from it in transit are very infrequent. While this deception is practiced upon, and permitted by the transportation companies, there will of course be no difficulty in supplying the country with ether from the large centres of manufacture, and the transportation companies probably wink at the deception, first, because they want freights, and next because they know that, as common carriers, they could be forced to carry ether as a commodity of necessity, if plainly marked so that they could take proper care of it and charge for the service according to the care required, just as all underwriters charge for the risks they assume. The writer has long since adopted a general

rule not to pack over one pound of ether in glass in any box of general supplies without marking the box plainly with the word "Ether," but has found it very difficult to satisfy his customers by the omission of ether ordered in large quantities in glass. No method of transporting or using ether has ever been devised that is at all equal to soldering it up in tin, and it is very curious and irrational that this method now in use for many years should have proved so unsatisfactory as to prevent its general adoption. It is, beyond doubt, the only proper method of putting up and transporting ether, because by it the ether is wholly preserved in a perfect condition, and is transported and used with general safety,—or at least with the smallest possible risk. In this the writer speaks from an experience of over twenty years, averaging, perhaps, 20,000 pounds a year transported to all distances, extending to central China. Throughout the whole duration of the war, and all its rough usages, the ether in tins was always safe and in good condition; the writer having one can now that belonged to a lot captured at Winchester and recaptured in Fort St. Philip; and another can, in a very battered condition, but still whole and sound, that was taken from the ruins of a disastrous fire.

The tins are very much thinner and lighter than bottles, thus saving room and freight, while they secure their contents better and are less expensive. The soft metal stud that is soldered over the mouth is about as easily removed as a cork or stopper, and leaves a smooth neck which is very easily stopped with a very small cork. These tins are so safe that they can be packed without being marked, and thus practice no real deception upon the transportation companies. The smaller sizes are very convenient for dispensing, because they are quite appropriate to the uses of physicians and surgeons, to be opened as required. In short, there is no known objection to them, but only an irrational prejudice which offers no reasons, but which, though very stubborn for years, is now rapidly yielding. Each tin is proved, after being filled and soldered up, by being plunged into hot water about 20° above the boiling point of the ether. This almost instantly gets up a pressure in the tin that is short of bursting it, but which causes a stream of bubbles to flow from any leak not before detected; yet, after all this precaution, somewhere about two tins to the thousand will reach their destination wholly or partly empty. That is, leaks so small as to escape detection in the proving process,—or so small as to be invisible in the necessarily rapid process, in hands

not always careful enough,—will still be large enough to empty the can by the agitation of transportation. Such losses are always made good, and expenses paid, provided the empty can be returned, because such loss is always through the fault in the can itself, and cannot be the result of either leakage through a fairly good stopper, or of breakage from rough and careless handling in transportation.

Many readers of these lines will undoubtedly recall instances in which their tins have been accidentally dropped under circumstances which, had they been bottles, would have made a conflagration inevitable ; hence this long commentary upon the new pharmacopœial direction to preserve ether in soldered tins may be excusable so long as the prejudice against them, and the objections to them continue.

The statement in the tests that this ether dissolves in 8 times its volume of water at 15° C. (59° F.) is a mistake, and as this is a very simple and good test of the absence of an undue proportion of alcohol, it should be corrected. When 10 c.c. of the officinal ether was shaken vigorously and repeatedly with 80 c.c. of water, at all temperatures up to 19° C., there was still 1 c.c. of the ether separated out. And 102 c.c. shaken with 100 c.c. of water at 16.2° C. separated into 87 c.c. of ether saturated with water, and 113 c.c. of water holding most of the alcohol out of the ether, and saturated with ether, there being a contraction of 2 c.c. on mixing the liquids.

The true boiling point of this ether is very difficult to determine, but it is certainly much below that given in the Pharmacopœia. The writer has repeatedly seen it boil distinctly in the s.g. flask when the flask was in a bath kept at 25° C. = 77° F., and that with ether which was nearly free from dissolved air. But as it does not always boil in taking the s.g. at this temperature, and as the boiling is slight and partial only, though continuous, this cannot be regarded as its true boiling point. This true boiling point the writer has never been able to obtain, but only knows that it is incorrectly stated by most authorities.

The test by observing the odor as a portion of the ether evaporates from blotting paper, determines the cleanness of the ether, a quality of very great importance, but this simple test, in order to be properly discriminative and useful, must be made with a considerable quantity of the ether and with great care. Not less than two fluidrachms should be poured onto the paper for an ordinary testing ; and for a close application of the test about a fluidounce

should be poured upon a dinner plate, and be moved back and forth by tilting the plate until it has all evaporated. During the latter part of the evaporation the odor should be closely observed, but not too frequently, because the ether will soon paralyze the olfactory nerves. Just as the last of the ether has passed or is passing off, when the cold surface of the plate is simply moist with condensed water, the odor of any uncleanness is most marked. It is almost impossible to make large quantities of ether that will stand the very critical application of this test,—nor is it necessary to the best uses of ether that it should do so, but it certainly should be practically clean to an ordinarily good sense of smell which is not blunted by too much ether beforehand. A highly cultivated or very keen sense of smell will always detect some foreign odor by this test if the test be pushed to its utmost limit.

The test, by shaking 10 c.c. of the ether with an equal volume of glycerin in a graduated test tube, is a very good one, except for two practical difficulties in its application. First, the glycerin is so thick, even in warm weather, that it requires very vigorous, prolonged and repeated shaking to bring it into intimate mixture with the ether; and secondly, when so mixed the separation of the last portions of ether from the glycerin is very slow, and requires too long a time for ready use in testing. After twenty-four hours' standing, at a temperature of about 25° C., the glycerin layer is still very opalescent with very minute globules of ether, which are prevented from separating by the viscosity of the glycerin. It will doubtless separate in time, but two days is not sufficient. At the end of 24 or 36 hours, however, the separation is practically sufficient, and then the indications are moderately and sufficiently accurate. The action of the test is based on the mutual insolubility of absolute ether and absolute glycerin, while the glycerin dissolves and holds both alcohol and water, and has the superior affinity for them. Thus if the agitation be effective enough, at the end of it the glycerin has dissolved out nearly all the alcohol and water, leaving the ether practically free from either. But the time required for the separation of the liquids is too long for a ready test, though the test be, in its results, a very good one.

In the application of the test, however, by the Pharmacopœia there must be either a mistake or a misprint. The text says the ether layer, when fully separated, should not measure less than 8.6 c.c. But this 8.6 c.c. corresponds to a loss of 1.4 c.c. of alcohol and water, which from 10 c.c. amounts to 14 p.c., and an ether con-

taining 14 p.c. of alcohol and water, or anything like it, is entirely unfit to be considered as "Stronger Ether," and is entirely inadmissible under this head. It has been shown that the ether as described and defined by the Pharmacopœia,—namely as having a s.g. of ·725 at 15° C. contains about 95.9 p.c. of absolute ether and 4.1 p.c. of alcohol and water, but here is a test that will pass any ether containing not more than 14 p.c. of alcohol and water; or, in other words, any ether not above a s.g. of ·737 at 15° C.

When 10 c.c. of strictly officinal ether was well shaken with 10 c.c. of strictly officinal glycerin, at about 25° C. = 77° F., the liquids did not fully separate in two days, but at the end of twenty-four hours they might be considered to have practically separated, at least, to within ·2 c.c. of the ether by guess. Then the ether layer measured fully 9.6 c.c., which is about what it should measure, thus indicating an ether of about 96 p.c. as it really was. Therefore had the text said 9.6 c.c. instead of "8.6 c.c.," it would have been right, and the ether would have accorded with the description and definition given, while as it stands it does not agree within 10 p.c.

To a strictly officinal ether 6 p.c. of alcohol s.g. ·820 was added, and this diluted ether was then subjected to the glycerin test, as directed by the Pharmacopœia. In 24 to 36 hours the separation was not complete, but admitting that it was practically complete, the ether layer measured 9 c.c., thus indicating an ether of about 90 p.c. absolute ether, or of a s.g. of ·732 at 15° C., which is just about what it really was.

Thus by this test an ether is admitted to be officinal when not up to the description and definition given by 10 p.c. of alcohol and water.

When this test is simply modified by the substitution of water for glycerin, five minutes is sufficient for the shaking and separation. The water should be put into the graduated test-tube first, and then the ether be carefully poured upon it down the side of the tube held in an inclined position until filled nearly to the mark. A few drops carefully added then adjusts it to the mark. Two or three minutes of active shaking is sufficient here, and then an equal length of time for the separation and draining down to the levels. Then in reading the levels it will be observed that a total contraction of volume of ·1 to ·2 c.c has occurred, and if the ether be strictly officinal by the s.g. definition, the ether layer will read not less than 8.8 c.c. That is to say, the water has taken out about ·41 c.c. of alcohol and water from the ether, and this alcoholic water has dis-

solved about ·81 c.c. of the ether, making, say, 1.22 c.c. in all. Then the ether has dissolved about ·02 c.c. of water, the result being, practically, an ether layer, consisting of 8.78 c.c. absolute ether and ·02 c.c. of water; and a watery layer below consisting of 9.78 c.c. of water, ·81 c.c. ether, ·41 c.c. alcohol, s.g. ·820, and ·2 c.c contraction in total volume. This is counting the entire contraction as water.

The same water testing applied to strictly officinal ether s.g. ·725 at 15° C., to which 6 p.c. of alcohol s.g. ·820 had been added, gave a reading on the test-tube of 11.4 c.c. of lower watery layer, and 8.3 c.c. of upper ether layer, and a total contraction of nearly ·3 c.c.

Thus, a strictly officinal ether gives an ether layer, measuring 8.8 c.c. or 88 p.c., while each ·12 c.c. less than this indicates 1 p.c. dilution down to an ether of 90 p.c. strength. That is, 8.8 c.c. indicates roughly a 95.9 p.c. ether;—8.7 c.c. a 94.7 p.c. ether;—8.6 c.c. a 93.5 p.c. ether, and so on down to 8.3 c.c., which gives a 90 p.c., all being approximative only.

This is by far the simplest, easiest, best and, therefore, the most useful approximate test of the strength of stronger ether down to 90 p.c., but is not trustworthy for dilutions below that for obvious reasons; and it has the great merit that it can be applied within ten minutes, and requires only a graduated test-tube and a good cork for it. The graduated test-tubes on foot, more recently made by Messrs. Whitall, Tatum & Co., are exceedingly convenient for all such testings as this. Indeed some such tubes are indispensable to pharmacopœial testing in general, while those of the above named makers are well made, are fairly accurate and are not costly. Two or three of the round-bottomed tubes, for warming, and two or three on foot form a very good outfit.

Although ether has many uses in medicine and pharmacy, and is rapidly increasing in uses as a solvent, yet by far its most important use in medicine is as an anæsthetic. As an anæsthetic it is the only one adapted to general use, and really appropriate to all uses, and with the exception of nitrous oxide is the only safe one for either general or special uses. The gravity of the condition known as anæsthesia is too apt to be overlooked, and then the advantages of a safe anæsthetic are not fully realized, hence it may not be amiss for the writer to reproduce here the best presentation he can possibly make upon this point, from a paper on anæsthetics read by him before the Medical Society of the State of New York,

at its annual session of 1871, and published in its Transactions of that year, at p. 197; and also published in the New York Medical Journal of April, 1871. The introduction to the paper is not quoted literally here, but is slightly altered to embrace the progress of the past thirteen years since its publication.

Time that tries all things, has disposed of many of the issues which arose in the earlier application of anæsthesia, but has entirely failed in producing that universally applicable anæsthetic,—that philosopher's stone for which the alchemists of the profession still vainly search,—namely, an agent which shall be potent, but potent only for good. This physicial impossibility seems to be to medicine what perpetual motion is to mechanics, and time wears away such heresies very slowly. It would, doubtless, be better for the profession and for mankind, if the safer of the anæsthetics already well known were better studied in relation to their special adaptation, and were applied with a more wise discrimination.

The condition of full anæsthesia is one of the most grave and frightful conditions of life, for by suspending more than half of vitality it comes so near to death as to be easily recognized as one of the stages of dying, and it is wonderful to see how near the boundary-line can be approached and yet be so rarely passed. Familiarity with anæsthesia and a distant view of its accidents, lead the profession to plunge their patients into it with too little regard for its true nature and gravity. The condition now so common when seen but a few years ago, never failed to excite the gravest apprehension; and even now, when seen as the effect of other narcotics, is called poisoning,—causes much anxiety, and secures the most active measures for relief.

The roughly-expressed, though perhaps practical condition essential to anæsthesia is diminished oxidation or diminished vital action in the sensorium; and the primary object is to confine this within the limits of safety. It is a kind of partial asphyxia or suffocation occurring not in the organs of respiration and circulation primarily, but far back of these in the tissues where the vital power is generated or renewed. The air passages normally admit oxygen, and the blood takes it up and carries it, but carries with it an agent which prevents or modifies its assimilation in the tissues which supply the vital forces. To diminish this assimilation or this supply seems to constitute anæsthesia. To arrest or prevent it is death by narcosis. Hence the line of greatest safety in practice is to regard the difference between anæsthesia and death as a difference in degree or

quantity only. The condition may be partial, full, profound, or fatal, but with no distinct boundary-lines between the degrees. The two intermediate degrees or stages constitute anæsthesia proper, and the full anæsthesia is generally required in surgery, while the stage of partial anæsthesia is generally sufficient in medicine. In the production of anæsthesia, the more powerful, prompt and efficient the agent, and the larger the dose, the greater the liability to overleap the intermediate stages, and unexpectedly extinguish life.

This seems but plain, common sense, and physicians are very familiar with the principle, in the action of all toxic agents and in the toxic influence of all acute diseases, and yet they often fail to apply it in their selection of the agent and the dose to produce this most acute of all diseased conditions, wherein the issues of life and death are narrowed down,—not to days or hours, but to a few minutes. Add to this the fact that this condition rests with the physician or surgeon whether to produce it or not, and it is difficult to understand how its importance can be over-estimated.

The condition known as anæsthesia must therefore be admitted to be in itself a dangerous one, and dangerous in proportion to the degree to which it is carried. And it must also be admitted that when the degree of full anæsthesia is reached, the signs which mark the approach of the profound and fatal stages are very much masked by the condition itself, so that the attempt to maintain the safer stage may produce those which are less safe without recognition of the fatal progress until one of two or three things suddenly occurs, with a more or less sudden death.

Then if the condition of anæsthesia be a dangerous one, all anæsthetics must be dangerous ; and to prove that all are dangerous it is only necessary to remember that the number of deaths fairly charged against all of them is quite numerous, and the number is increasing against all.

Nitrous oxide has probably been used by far the largest number of times, and has probably saved the greatest aggregate amount of pain, yet it has produced by far the fewest deaths, and although applicable to the largest number of cases, it is not appropriate to the very large number of the most important cases requiring anæsthesia.

Ether, beyond all question, stands second in the rank of safety, having had the largest general application next to nitrous oxide, and by far the largest application of all, if the importance of the cases and the duration of the anæsthesia be considered, and yet the

number of its deaths are not very greatly in excess of nitrous oxide. If it be remembered that nitrous oxide is commonly used for momentary effect upon healthy individuals, as in dental practice, while ether is used for prolonged effect in diseased or debilitated conditions, or after shock, it will be easily seen that the balance of safety in favor of nitrous oxide may belong to the conditions of application rather than to the agent. If nitrous oxide was used as ether is, it would probably have as many deaths to account for, while if ether was used only as nitrous oxide is, the number of deaths would probably be as few.

The proportion of deaths to the number of cases of using either of these agents, is, however, very small indeed, and perfectly justifies their use. To refuse their use when any considerable amount of pain is to be saved, is about as irrational as to refuse to go upon the water or by the railroads. This, however, is not the case with any other anæsthetics known. It may probably be said, with truth and justice to all the interests involved, that for the production of full anæsthesia in general practice no surgeon is justified in the use of chloroform or any other known anæsthetic when good ether is accessible, because the proportion of deaths to the number of cases under the use of chloroform and other anæsthetics is very greatly in excess of those from ether, probably not less than five to one.

There is probably a chemical reason for the comparative safety of nitrous oxide and ether, although it may not be easy to show this, independently of the fact that they are more safe. Nitrous oxide is a rather loose combination of two elements, both of which are very important normal constituents of the tissues present in large proportion throughout the body, and when nitrous oxide has done its work as a compound, and splits up, either in the act of doing its work, or afterward,—or more important still, when the surplus of it either combines with other elements for elimination or splits up for new compounds, it is not rational to expect, nor consistent with known chemical laws, to find any toxic or hurtful action from either of the elements or their probable or possible new combinations. All the tissues of the body are saturated with the two elements in the air in and by which the body lives, and when nitrous oxide splits it forms air, or enters only into such new combinations as air does. As the elements of nitrous oxide uncombined constitute atmospheric air and are continually breathed as essential to life, it follows that it is merely the combination of the elements in a given proportion

that makes the gas an anæsthetic at all, and as in its action as an anæsthetic it is probably decomposed its resultants may easily be as harmless as air,—or might even be as beneficial as air. From this line of reasoning it is very hard to see how nitrous oxide can ever be poisonous, or how it ever could produce death, and it is therefore not impossible that all the deaths that have occurred from either nitrous oxide or ether were mere accidents, precipitated by the anæsthesia rather than by the agent producing it; yet as they would not have occurred without the anæsthetic they are most properly charged to it.

Again the three elements of ether are all normal to the economy and go to make up, say roughly, nine-tenths of the organism. No one of the three is known to be poisonous or hurtful in itself, nor is any new combination of any two or three of the elements known to be possible under the conditions of the organism, either toxic or hurtful. Carbonic oxide, as an example of some combinations of the elements that might be formed, is known to be poisonous, but the conditions under which such compounds are formed not being present, nor, so far as known, possible, the compounds themselves are impossible. In chloroform and other anæsthetics other elements are present, less natural or less wholesome to the organism, and from which a greater number of more hurtful combinations could be calculated upon their decomposition.

In the use of ether as an anæsthetic there is great room for reform. Just how small a quantity of ether would produce full anæsthesia in the average adult subject is not known, though that is exactly what is wanted, but it is entirely safe to say that more than half the ether taken for this purpose is wasted;—and not simply wasted but injuriously saturates both the patient and attendants. Indeed the writer has frequently breathed the atmosphere of small ante-rooms, when patients were being etherized, where the proportion of waste ether vapor was so large as to render the air pretty certainly explosive. Ether vapor has a very considerable tension or power of diffusion, and air becomes nearly saturated with it very quickly and very easily; and such air is very actively anæsthetic. It is a habit in laboratories when a flask or bottle, having been washed, has to be quickly dried for use, to rinse the water out first with a little alcohol, and then to rinse out the alcohol with a little ether. Then by inserting a tube to the bottom of the bottle and drawing the air into the lungs by applying the mouth to the other end of the tube, all the ether may be quickly drawn out in the state

of vapor, leaving the bottle dry and free from ether. Now this does very well with small bottles, but when the ether with which a two gallon bottle has been rinsed out, is poured out as far as possible, about one or two fluidrachms remain in the bottle spread over the interior. The first and second inspirations through the tube are but partial, being interrupted by coughing or closure of the glottis, but they serve to so anæsthetize the air passages that the fourth and fifth inspirations and all that follow may be deep and full. It has often happened to the writer that before the ether vapor is all drawn out of the bottle the stage of excitement has passed, and that of anæsthesia is so well advanced that the tube can no longer be held to the lips. In a personal experiment, based upon this experience, a half fluidounce of ether contained in an eight-ounce wide-mouth bottle, was shaken round the bottle and the vapor simply smelled deeply with full inspirations, the bottle being removed and shaken round during the time of expiration. Seated in an arm chair in such a position as not to be likely to fall, the smelling, in less than half a minute, had passed the experimenter through the stage of stimulation, and could only be continued by determined effort, the bottle constantly tending to slip from the hand, and the arm almost refusing to move by order of the will. Sleep must have occurred before the power was entirely gone, for on waking it was found that ten minutes had elapsed since the beginning of the experiment,—the bottle was found on its side on the floor, but with a considerable portion of the ether still in it.

From this it is quite certain that from two to two and a half fluidrachms if all utilized in the way described is sufficient to anæsthetize one who is quite habituated to a prevalence of ether vapors around him.

In the paper on anæsthetics by the writer, previously referred to, he gave some testimony upon the waste of ether, and upon the great probability that the supersaturation of patients.—or the use of too much ether had a great deal to do with the sickness and vomiting that so often follow its use, if not also with other more serious accidents,—and also gave a description of a very simple home-made apparatus for the better and more economical administration of ether. This apparatus, as well as modifications of it upon the same principle, he had used successfully for a considerable length of time, and he continued to use the one there described and illustrated, for some two years after the publication of the paper, and for as long as he continued to administer ether at all, and always with a

good degree of success. In several large hospitals the use of it was shown and the economy and benefits of it demonstrated, but all soon abandoned it for reasons not known, and it soon went out of use altogether for newer fashions. By it, however, the writer demonstrated the fact that about twelve fluidrachms of ether, on a general average, was sufficient to produce anæsthesia, and after that the quantity needed to keep it up was proportionate to the length of the operation, if that exceeded two minutes. Dr. Snow, of London, Dr. F. D. Lente and many others have shown, before and since that paper, that this quantity was ample, or perhaps excessive, and yet at this late day it is not uncommon to see a half pound, equal to more than ten fluidounces of ether, used at an ordinary operation. Of course in such a case three-fourths of the ether is wasted through defective management.

In the administration of ether it should never be forgotten that the vapor when too much diluted with air is a simple stimulant to most persons, and will only produce excitement and drunkenness, no matter how much may be used, or for how long a time ; and farther, that when too little diluted, and the mechanical act of respiration at the same time obstructed by pressing down the cone or sponge or other apparatus, any person may be very easily, either partially or entirely suffocated. The writer saw a case of strangulated hernia brought into a large hospital many years ago. The physician directed his assistant to use plenty of ether and press the cone firmly down so as to avoid a lengthened stage of excitement. This was done and the hernia was reduced during the relaxation, but the patient was dead,—drowned, in all probability, in ether vapor. The first sudden application produced strangling and probably closure of the glottis for a few seconds, but then all was quiet.

Nothing in the writer's experience and observation tends more to the prompt and successful effect of ether than the avoidance or prevention of this strangling or interference with the mechanical act of respiration. These short, shallow and imperfect inspirations, and the irritation produced, admit of very little of the vapor being utilized as long as they continue, and thus a minute or more is often wasted and only harm done. This strangling may in almost every case be avoided by a previous partial anæsthetizing of the air passages. If, for a minute or two before any apparatus be applied the patient be made to smell a little ether from a bottle or tin,—gently at first, and then more deeply, there will be no coughing, and the patient's head will soon begin to swim. If the apparatus be now

applied there will be no strangling, and full, deep, effective inspirations will be secured,—and a very few such are sufficient to produce full anæsthesia if the ether vapor be then strong enough.

A new fashion has lately been introduced of producing anæsthesia by the introduction of ether vapor into the rectum and colon, and however irrational and unpromising, it soon found numerous followers. The result is that although several lives have been sacrificed even in the short time since its introduction, it is still practiced and recommended. The absorption of ether vapor by the walls of the intestine must necessarily be irregular and uncertain, in consideration of the known phenomena of local anæsthesia, for if the walls be thoroughly paralyzed and relaxed by the anæsthetic, the contained vapor might as well be in a distended bladder outside the body. But if no obstruction by feces or by spasmodic contraction should be present, and the vapor should pass far up in moderate quantities, insufficient to do more than stimulate the parts, the absorption might be very rapid. In short, the conditions of such an application are so little known and so little under control, and are so far beyond the reach of observation, that for the present, at least, the method is irrational and unjustifiable.

It not unfrequently happens to the writer to get grave complaints of the quality of the ether made by him, involving a difficult, troublesome and time-taking correspondence. These complaints are principally of two kinds. One class is that the ether is so strong and so irritating that patients' lives are endangered during operations, or sacrificed from the after effects, the vomiting only ceasing with the life of the patient. In such cases an appeal to the quality of the ether as being easily ascertained by the tests seems to be of as little use as to suggest overdosing and oversaturation. The other class of complaints is to the effect that the ether is too weak, occasionally said to be little else than water, and it is not uncommon to hear of a pound or more being used with the effect of only making patients drunk. It is not often possible to get specimens of the ether complained of, but whenever these have been sent, they have in no instance sustained the complaint, though it is rarely possible to satisfy the complainant of this. The application of one or two of the most simple tests of the Pharmacopœia,—for example, the solubility in water, and the evaporation from blotting paper will at once show the character of the ether sufficiently for the purposes of such complaints, and will take far less time than the writing of a long letter to one who has not got the ether in question, and therefore

cannot examine nor report upon it. That ether can ever be watery is, of course, impossible, but it may be weak by dilution with alcohol, and it is often questionable whether pharmacists and physicians, who order simply "Ether," do not sometimes get what they order, namely, the "Ether" of the Pharmacopœia, which contains about 25 p.c. of alcohol, and is rarely wanted for any purpose in medicine. In the writer's experience in dispensing over 30,000 pounds a year, a very large proportion of the orders are for "Ether" simply. If such were supplied as ordered, of course the results would be disastrous. Fortunately there is no difficulty in guessing at what is wanted in this article, as there is in many others, because the writer has no demand at all for the Pharmacopœia "Ether," and it is never made or kept. Thus mistakes in sending it in the place of Stronger Ether are avoided, even though the orders, when properly and literally construed, call for it.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. SEPTEMBER, 1884. No. 5.

TEA AND COFFEE AS THERAPEUTIC SUBSTITUTES FOR COCA AND GUARANA.

The notes upon this subject in the last pamphlet of this series were incomplete in many respects, but especially so in regard to the limited number of assays made, the details of the process of assay, and the relation between the assays and the values of different grades of tea and coffee; and, as the investigations were continued, it is now proposed to give the results thus far reached.

In the assays of many other grades of tea it was found that they differed considerably in the rate of exhaustion, and in the liability of the concentrated decoction to gelatinize the chloroform by the agitation in washing out the caffeine. It is therefore better to add the 10 grammes of powdered tea mixed with the 2 grammes of magnesia to 150 c.c. of boiling water at first;—boil for five minutes;—filter and percolate to 200 c.c.;—boil again with 100 c.c. more water, and again filter and percolate to about 300 c.c. more,—making about 500 c.c. of solution in all, to be evaporated to about 20 c.c. This concentrated solution, rinsed round the capsule until all the dried rings of extract are redissolved, is poured into the separating apparatus described, and the capsule rinsed two or three times with successive small portions of water,—the rinsings being added to the original solution, when the whole will measure about 30 c.c. The 25 c.c. of chloroform is then added. With many kinds of tea the agitation in the separating apparatus may be by shaking, without gelatinizing the chloroform so that it does not separate at all, or

separates but imperfectly even on standing 24 hours. But with other kinds this gelatinization occurs, and the assay is thus defeated; or, the condition requires that the whole mixture be returned to the capsule and the chloroform be driven off in the water bath, to start the chloroform washing anew. It is therefore safest never to agitate the liquids together by shaking, but simply to bring the two liquids in contact by a rather rapid elevation of first one end and then the other of the separating apparatus, and continuing this carefully for about five minutes. If this be skillfully done the chloroform layer will separate completely in fifteen minutes, and may be drawn off into the tared capsule. But if the agitation be too active there will be an intermediate layer of inseparable gelatinized choloroform which requires twenty-four hours' standing, or perhaps does not separate at all. Such mixtures are now upon the writer's table which have stood for two months, and portions of which have resisted many devices to obtain a separation. Evaporated they dry up to a thicker and thicker jelly and finally to a dry transparent residue which always contains caffeine.

When so managed as to avoid this gelatinzation the washings with chloroform may succeed each other rapidly and be completed within an hour or two. The first washing usually extracts over 80 p.c. of the caffeine, and the second washing often brings off the remainder, yet it does not always do so, and therefore it is never safe to trust it. Three washings should always be used, and when there is an inseparable intermediate layer four washings should be applied.

Check trials were made by dissolving weighed quantities of caffeine both in the exhausted residues of both tea and coffee, and in water, and in all cases it was almost entirely recovered by the management here described. The tared capsule with the chloroform washings should be placed in a warm place, but the boiling of the chloroform should be avoided as entailing a loss of caffeine. The caffeine residue is never entirely colorless and varies with different grades of tea and coffee, but this small amount of coloring matter was always disregarded in these assays.

The following varieties of tea, from the wholesale market, or from "first hands," where there is no mixing or adulteration practiced,—were assayed for the purpose of ascertaining whether or not the best variety had been reached for making the fluid extract. The varieties are given in the order of their intrinsic value in the wholesale market, and the price per pound as given is the price for large quantities.

A fancy high-flavored Formosa Oolong,	85c.	per lb.,	contained	3.10	p.c. caffeine
Extra fine small leaf Gunpowder	65c.	"	"	3.51	" "
Formosa Oolong	55c.	"	"	2.80	" "
" "	45c.	"	"	2.74	" "
Basket-fired Japan	44c.	"	"	2.80	" "
" "	40c.	"	"	2.87	" "
Amoy Oolong, large leaf	25c.	"	"	2.95	" "
Congo, large, coarse leaf, North China	20c.	"	"	2.41	" "

This series embraces representatives of the tea market from the very highest to the very lowest prices and qualities. Teas sold below 20 c. per pound, are said to be mere dust or refuse from better grades, or imitations of tea made from other plants.

It will be first noticed that the yield of caffeine does not vary as much as might be expected, and really varies comparatively little; and next, that the disparity between the caffeine value and the money value is very great. The two values bear only a general relation, which is much confused by exceptions. The highest priced tea does not contain the most caffeine; while the next to the lowest in price ranks third in the proportion of caffeine. The lowest priced tea of all contains within ·7 p.c. of caffeine of the highest.

Now if the money value of the tea in first hands be accepted as the true economic value, then the proportion of caffeine is not a true measure of value. Even if the fancy, high-flavored, highest priced tea be put aside, the prices and caffeine strength agree no better. If the caffeine strength be the real basis of value in tea, then there is but one explanation that is easily reached of why a 25 c. tea is really better than a 55 c. tea, and that is, that the tea-taster who fixes the money value upon the lots as they go into the markets, does not, by his process, always get a true estimate of the proportion of caffeine contained. Then again, if the economic value of a tea be governed by its effects in use, creating a superior demand for certain grades, then the question of the comparative facility of exhaustion by culinary processes comes into the question. Some teas are much more easily exhausted than others, and the bearing of this fact upon the domestic using is, that much more of some teas than others is left in the dregs and thrown away. If the amount utilized was the same for every variety, and if the caffeine was the only element of value apart from mere aroma or flavor, then the price should always be in direct proportion to the amount of caffeine yielded by assay. That this is not the case is very apparent, and yet the yield of caffeine must still be considered as the best measure of value yet reached, although when extracted and

used separately it certainly does not represent the total effect of tea.

The chief object of the above given assays was reached in deciding that the fluid extract for therapeutic use should be made from the extra gunpowder tea, rather than from the basket-fired Japan tea, because the former yields ·64 p.c. or nearly one fifth more caffeine than the latter. That the difference in cost is 25 c. per lb., or 62.5 p.c., is of less importance, because it will only raise the price of the fluid extract by 25 c. per lb., or from $1.25 to $1.50, while the caffeine strength is raised in about the same proportion.

The average adult dose of the fluid extract from the Japan tea being about 60 minims, the equivalent dose from the extra gunpowder would be about 48 minims. By the physiological test as described in the last pamphlet, 56 grains of this extra gunpowder tea, powdered and swallowed in substance, with a little water, was about equal in effect to 56 minims of the fluid extract made from it, and to three grains of caffeine. But the 56 grains of the tea, and the 56 minims of the fluid extract each yield only 1.97 grains of caffeine. And this quantity of this same caffeine extracted from this identical tea, yielded an effect so slight as to be hardly recognizable when carefully looked for.

The standard to be adopted hereafter in making this Fluid Extract of Camellia, is to use a tea yielding as nearly as practicable 3.5 p.c. of caffeine, such tea being always obtainable in this market; and the average adult single dose of this is about 50 minims, or a small teaspoonful.

The fluid extract is perhaps best given to adults in about a wineglassful of iced water. The bitterness is neither intense nor disagreeable, and the after taste is an agreeable sweetish one, of a peculiar character, and is noticeable at intervals for three or four hours after the dose, or throughout the effect of the tea.

During a pretty long course of these physiological testings, generally with full effective doses, some after effects or reaction has been expected and carefully watched for, but none has been perceived. The strength and appetite and general well-being on the day or days which intervened between the evening doses, were always normal; and even after an entire week of full doses on alternate evenings no effect was discernible upon the secretions or excretions, or upon any of the functions of the organism. If there has been any general or broad effect from the three and a half months of trials upon a normal condition, it is tonic; and this embraces both coffee and tea.

Much information has also been gained in regard to coffee since the last pamphlet. In the process of assay the complete exhaustion of coffee is more difficult than with tea, and different varieties of coffee differ quite as much as those of tea, and hence the modifications or improvements of the assay process suggested in the case of tea are equally applicable to coffee, with the following additions.

When the decoction is evaporated to about 20 c.c. it should be added to 6 times its volume of strong alcohol, instead of the more dilute alcohol as suggested in the former note, because the stronger the alcohol the more completely is the extract freed from those matters which emulsionize the chloroform. When the concentrated solution or extract is shaken with 6 times its volume of strong alcohol,—the precipitate filtered out and washed with strong alcohol, and the alcohol evaporated off nearly to dryness, an extract is left which with careful management never gives any trouble in the washing with chloroform. This extract, after all the alcohol is off, is dissolved in successive small quantities of water, and being transferred to the separating apparatus is managed exactly as in the case of tea, the necessity for careful agitation to avoid making an emulsion which will not separate, being even greater than with tea. But with care the results are equally satisfactory.

This assay process is equally applicable to roasted coffee, the coffee being powdered and passed through a sieve of 60 meshes to the inch.

The following grades or kinds of coffee were obtained from the wholesale market, care being taken to avoid all admixtures, and also all polished and colored coffees. Many kinds of tea are "loaded" or adulterated with clay and coloring matters, but this is always done at the place of production, and during the process of curing. In the case of coffee, however, the loading and coloring is done here, and coffee polishing companies have become quite common, and carry on their business openly, often with signs over their doors. By the skillful use of machinery and coloring substances coffees are raised from one grade to another; and damaged and inferior coffees have their true character hidden so that they are sold at good prices. Certain coffees which cannot be so treated with success are mixed with better grades and roasted and ground, whereby their inferiority is equally well hidden. Such is the amount of ability, skill and capital now applied to these "polishing" and roasting processes that their results surpass all the efforts of the clumsy adulterator, and are well calculated to deceive the

most wary. Yet the deception is mainly practiced upon those who are constantly pressing for low prices. At least there are always sources of supply whence those who are willing to pay liberal prices for corresponding quality, can obtain the coffee they pay for in its best condition, either green or roasted, and such sources of supply are not difficult to find if the screw of price and the effect of florid advertising, be omitted in the search.

The following list does not embrace half of the principal grades of the market, and as in the case of teas, some of the special high qualities of the grades never reach this market at all, because they will not command the prices they bring in Europe. As in the case of tea, the kinds of coffee are given in the order of their market value.

Mocha, an Arabian Cofiee.....	23c.	per lb.,	yielding	1.05	p.c.	of caffeine
"	17c.	"	"	1.07	"	" "
Mandheling Java.....	23c.	"	"	1 30	"	" "
" "	23c.	"	"	1.22	"	" "
Interior Java.....	17c.	"	"	1.10	"	" "
Maricaibo.....	11c.	"	"	1.20	"	" "
Rio, strong and rank.....	11c.	"	"	1.00	"	" "
"	10c.	"	"	1 05	"	" "

The same disparity between market value and yield of caffeine is observed here as in the case of tea, but the caffeine value is much more uniform than in tea. The difference between the extremes is here only ·3 p.c., while in tea it is 1.1 p.c., the tea yielding on the average less than two and a half times the amount of caffeine.

In both tea and coffee the value is adjusted chiefly upon two elements, strength and flavor, and these elements seem to be, in a measure, independent of the yield of caffeine. In the case of coffee the aroma of the roasted seed seems to take precedence of strength, as it does in some of the fancy teas, but the aroma that any special quality of a grade or kind will yield cannot be predicted upon the green state but requires the roasting process, and requires that roasting process to be carefully controlled. The offices of tea merchants have long been supplied with round tables, in the centre of which is a small scale with a five cent piece on one pan. Around the scale is a circle of tin sample cans of tea, and outside of this a circle of as many tea cups. Near the scale is a spoon holder with some teaspoons in water, and in some part of the office is one or more bright copper tea-kettles of water kept boiling by gas jets. Of late the offices, or some separate room, of the coffee merchants is sup-

plied with a small coffee roasting cylinder, heated also by gas jets, so that the aroma of any given sample may be produced for an adjustment of the value.

The aroma of coffee is developed entirely by the roasting, and the quality of this aroma is a chief element of value, but the relation of the aroma and of the other changes by the roasting process to the effects of coffee upon the economy is very obscure.

While many authorities are silent on the point, others state that there is a loss of caffeine by the roasting process, and caffeine has been manufactured by condensing the vapors from the roasting cylinders and extracting caffeine from the condensed matters, but from experiments recently made for this paper it will be seen that there is probably a very small if any loss of caffeine, when the roasting is properly done with modern apparatus, in skillful hands. It is also generally stated that coffee is about doubled in volume, while it loses from 15 to 20 p.c. in weight by the roasting process; but these statements are all old, and do not apply well to the improved modern process of roasting. They, however, led the writer to adopt green or unroasted coffee for making the fluid extract, and the question whether this be the wiser course having come prominently up in these later investigations, it was concluded to review this decision. If there be no loss of caffeine by the roasting process, and if its effects be not injuriously modified, and if the aromatic substances produced by the roasting are really valuable in effect upon the economy, and are not mere matters of cultivated taste, then of course it would be better to make the fluid extract from the roasted coffee, with the incidental advantage of having a more agreeable and a stronger preparation.

In order to get some information upon these points 100 pounds of old Mandheling Java coffee was carefully weighed and carefully roasted to a full but not dark chestnut brown color, the color being very uniform throughout. When thus lightly roasted the aroma is strongest and best; and uniformity of the light brown color is not only an evidence of the skill of roasting but also of the quality of the coffee, since light and heavy seed, or that which is perfect and imperfect, or small and large seed, mixed together,—will, by the same heating, roast to different degrees and therefore to different colors. The 100 pounds roasted yielded just 87 pounds, indicating a loss of 13 p.c. As stated by the roaster this was below the average loss, because the green coffee was old and dry. The average loss, taking new and old together, was stated to be

about 16 p.c.; and never above 18 p.c. as the extreme, if the roasting was properly done. While still quite warm from the cylinder it was put into tight tin cans to avoid the absorption of moisture, and to preserve the aroma.

Another portion of 100 pounds of the same kind of coffee from a different source, was as carefully roasted, and was also carefully ground. The yield of roasted coffee was 85 pounds, and of ground coffee 84 pounds.

Samples of these two lots of Mandheling Java, and of one lot of Interior Java, were taken just before they were put into the cylinder to roast, and just after coming out of the cylinder roasted, and were carefully assayed.

The Mandheling yielded from the green .... 1.22 p.c., roasted 1.45 p.c. caffeine.
" Interior " " " " .....1.14 " " 1.40 " "

Now the first variety after losing 13 p.c. of moisture and without any change in its proportion of caffeine, should yield about 1.40 p.c. caffeine, but it really gave 1.45 p.c. This caffeine, however, was of a darker color, and seemed somewhat more oily than that from the same coffee when green. Its physiological effect when administered was, however, quite equal to that from the unroasted coffee, and quite equal to that of pure caffeine as far as could be discovered from close observation of frequent comparative trials.

From this it would appear that properly roasted coffee loses no caffeine in the process of roasting, but gains largely in aroma, and becomes at least 13 p.c. stronger in caffeine, and in the coffee effect in addition to the caffeine effect, while it is much more agreeable in odor and taste. Roasted coffee would therefore seem to be better adapted to making a fluid extract for therapeutic uses than the green coffee; and if so, would be a better substitute for guarana, and a better alternate for tea.

A fluid extract of roasted coffee was then made with the same menstruum and by exactly the same process as that given for fluid extract of camellia at page 608, except that the powdered coffee requires to be moistened with about its own weight of the menstruum, and to be packed more firmly in the percolator. It is more easily percolated and much more easily exhausted than tea, and yields a more fluid extract. The finished fluid extract is of a very deep, rich brown color,—almost black, slightly syrupy in consistence, with the well-known odor and taste of well made, good coffee. The odor and taste are highly characteristic of

the kind and quality of the coffee from which it is made, and are very much developed when the fluid extract is poured into hot water. From being made entirely without heat, very little of the aroma is lost and no part of the strength, so that it represents the coffee most accurately and most exactly; and it is quite probable, though by no means certain, that in this liquid form the aroma may be better preserved than in the coffee itself. It is well known that the caffeine undergoes no change by keeping in either green or roasted coffee, either in quantity or quality, but it is equally well-known that the aroma of roasted coffee undergoes much change, and deteriorates rather rapidly by keeping, unless the coffee be kept in very close vessels. Indeed in some Oriental countries where the making of coffee as a beverage is supposed to be in its greatest perfection, it is roasted, and bruised in a mortar, for each separate making, and one to two hours' time is required to yield a cup of coffee. Should this cold-made fluid extract with its small proportion of alcohol and glycerin be as successful in protecting this aroma against deterioration by keeping, as the same agencies are with other aromas, it would give it this advantage at least over the similar preparation from green coffee. Every one knows that for the aroma of coffee it must be drank as soon as made, but for its best effects this has never been shown to be necessary.

In consideration of these circumstances the writer offers to any who may desire to use it, a fluid extract of roasted coffee in addition to the already described fluid extract of green coffee, so that in actual practice it may soon be decided which is the best preparation for therapeutic use, so that the other may be dropped, for certainly both are not necessary.

This Fluid Extract of Roasted Coffee has been tried physiologically in exactly the same way as were the fluid extracts of coca, tea, guarana and green coffee, using both pure caffeine, and the identical caffeine from the roasted coffee itself, to measure and compare effects by. It was found by three trials that two fluidrachms or 120 minims of this fluid extract were fully equal in effect to 3 grains of caffeine, although this 120 minims only contained 1.68 grains of caffeine. This same dose of 120 minims was equal in effect to 180 minims of fluid extract of coca;—to 70 minims of fluid extract of tea;—to 60 minims of fluid extract of guarana, and to 150 minims of fluid extract of green coffee.

The single adult dose to begin with, equivalent to one grain of

caffeine, would be about 40 minims ; but a trial of it would be incomplete until it was pushed to some physiological effect, or some change of pathological condition, and this might not be reached short of two or three fluidrachms,—or of frequent repetitions. Migraines or sick headaches are occasionally averted or relieved if taken in time by doses of half a grain to a grain of caffeine. Such cases would probably be better treated by 20 to 40 minims of this fluid extract. As a stimulant in the treatment of the opium and alcohol habit, or in narcotic poisoning, of course very much larger doses would be required, and probably 4 to 6 fluidrachms would be quite safe, and might be safely repeated if required.

It may be administered in syrup or in wine, but perhaps best upon a little cracked ice, or in a small quantity,—say two fluid ounces,—of iced water, with which it makes a clear solution. To most persons the taste and flavor is quite agreeable,—much more agreeable than green coffee. In migraines or sick headaches or other conditions wherein the stomach is a prominent factor, sugar should generally be avoided.

An attempt was made to get at the quantities of coffee utilized in its domestic use in order approximately to see the relation of the doses habitually used by coffee drinkers to those suggested here for therapeutic uses. A good cook in the daily habit of making five cups of good coffee from the Mandheling Java, was asked for the amount of ground coffee which she used daily. This quantity weighed 138.7 grammes, which is 27.7 grammes for each cup, or very nearly an avoirdupois ounce. As this coffee yields 1.4 p.c. caffeine, this would be equivalent to ·3878 gramme or 5.985 grains of caffeine. But a large proportion of this is not utilized, and the quantity appeared so large that another trial was made, after an interval of a couple of weeks. The same cook was then asked for just enough coffee to make four cups. This was found to weigh 101.5 grammes or 25.4 grammes for each cup. Another portion of exactly the same weight of the same coffee, ground at the same time, was taken. One portion was made into the four cups of coffee, which were drank at breakfast, all that remained in the pot being carefully taken for assay. No more coffee could have been poured off this residue clear, and therefore none was wasted in the making by this method; but when put upon a filter about another cupful came through nearly clear. The residue was then carefully exhausted by being boiled twice with fresh portions of water,—all the decoction was evaporated with excess of magnesia and treated

exactly as in the process of assay given. It yielded ·702 gramme of colored caffeine. The duplicate portion of 101.5 grammes, taken at the same time, was assayed in the same way and gave 1.42 grammes of caffeine. From this it appears, first, that just about one-half of the coffee is lost in the usual domestic process; and secondly, that in each cup of good coffee there is (·72 ÷ 4 =) ·18 gramme or 2.78 grains of caffeine that is extractable by the assay process.

But it has been shown that an amount of roasted coffee yielding 1.68 grains of this caffeine, namely, 120 grains, or 120 minims of the fluid extract, produced an effect equal to 3 grains of pure caffeine. Therefore a cup of coffee which yields this 2.78 grains should be equal in effect to (as 1.68 : 3 : : 2.78 :) 5 grains of pure caffeine, or nearly double the maximum single dose of the German Pharmcopœia. It is seen therefore, that between coffee as a dietetic, and coffee as a medicine there is a very great discrepancy, and that there can be no great danger in the therapeutic use of large doses when small ones do not answer, since a dose of the fluid extract of roasted coffee equal in coffee strength to a cup of dietetic coffee would be nearly 200 minims, or 3.30 fluidrachms. It should be remembered, however, in the therapeutic use of tea and coffee, that much larger doses are required for those who are habituated to its use as a dietetic ; and it should also be remembered that coffee at a meal is subjected to the digestive process with considerable quantities of food, and is probably largely digested, being split up as the food is, and utilized in new combinations, and therefore does not yield its full quantitative coffee effect ; whereas, if taken into the empty stomach and alone, or with some simple diluent, it is at once absorbed into the circulating fluids. In the use of alcoholic stimulants such a difference in effect is very marked.

COPPER AS THE CAUSE OF THE GREEN COLOR IN PREPARATIONS OF CANNABIS INDICA.

In an "original communication," by Mr. Henry Maclagan, published by the *American Druggist* of July, 1884, page 121, it is stated that the green color of extracts of Cannabis Indica is not natural, but is due to copper introduced by manufacturers either purposely, or through ignorance of the fact that copper vessels

should not be used in the making of resinous extracts similar to that of Indian hemp. In conclusion, the author states that this extract cannot be of a green color without being contaminated with copper.

This publication has excited uneasiness among physicians who use this important drug, and the writer as being the maker of perhaps the very greenest of the extracts of the market has had frequent and serious inquiry in regard to the statements.

It is not easy to understand how a writer of ordinary intelligence, in an influential public journal, should overlook the circumstance that a drug containing a large proportion of green chlorophyll, when of good quality, might yield to a good solvent of this green chlorophyll, a green extract. This it certainly does, and all extracts of drugs containing unaltered green chlorophyll; especially when extracted by a strong alcohol, are naturally of a green color, the depth of which color is proportionate to the amount of the green chlorophyll which escapes the drying and heating processes unchanged. These facts are so well known, and have been so long known, that it is not necessary to prove them now; but if they be admitted they disprove the statement that a green color is not natural to an extract of cannabis indica. And yet if this statement be disproved, and it be positively shown that the green color is not all of it due to the presence of copper salts, as is very easily done, this does not prove that some of the green color may not be caused by copper salts, or that copper salts may not be present in either green or brown extracts in hurtful quantity. Thus it often happens that broad and positive statements incautiously made on insufficient grounds, cost the maker of them very little; but in justice they cannot be disproved by mere improbability, nor by simple contradiction; and if taken notice of at all they must be disproved by accurate determinations published in such a way that they can be repeated by all who choose to verify them; and this often takes days of careful work, as in this case.

There are doubtless always traces of copper and iron and many other things in most drugs, and in most preparations made from them, and such traces may be considered normal, as practically they are not, and cannot be avoided. Yet to be normal the quantity must be limited to such traces, and it is very difficult to draw a line of definition to control this quantity. Doubtless when copper vessels are used at all, such traces, if not pre-existing in the drugs, must be almost always present, and be discoverable in proportion to the delicacy of the tests applied to find them, and the practical

safety in the use of copper vessels does not depend upon these traces of metal at all, but upon reactions which bring the metal into the products in much larger, and in hurtful quantities. Now it happens that in Indian hemp there are always ripe and partially ripe seeds. These seeds contain a large proportion of oil. This oil in the presence of metallic oxides and some metallic salts, is easily split, the oleic acid combining with the metallic oxide. Oleate of copper is a most intensely green salt, and a very small proportion of it serves to give a very intense green color to a large proportion of other matter. A knowledge of these facts in the presence of the statements of Mr. Maclagan rendered the writer uneasy in regard to his own extract of Indian hemp, and he therefore undertook to investigate the matter as far as the application of the statements to his own extract go.

The writer has always been very careful in the selection of Indian hemp to get it as green and as fresh as possible, and it is comparatively rare that the markets of New York or London yield a good quality of this important drug. The drug is ground in an iron mill, and is then exhausted by repercolation, in pots of stone ware, by strong alcohol, s.g. ·820, and throughout this part of the process no copper nor any other metal has contact with either the drug or its fluid extract, yet this fluid extract is of an intense brownish green color. The fluid extract is then put into a bright copper still, care being taken that the metal is always bright,—that is, free from oxide. Tha alcohol is distilled off for use with fresh portions of the drug, and the alcoholic extract is then transferred to porcelain or porcelain-lined iron, shallow dishes, where it is evaporated down to the proper consistence at a low temperature by mechanical agitation. When transferred from the copper still the thin extract does not leave the surface of the copper clean and bright as it was, but much tarnished as though by a thin coating of oxide, and this is not easy to scour off. The resulting extract is of an intense olive green color, and the question was whether it contained copper, and if so, how much.

Ten grammes of the extract was taken and dissolved to a liquid condition by a small quantity of strong alcohol, and the liquid was acidified by 1 c.c. of nitric acid, added drop by drop with constant stirring. The whole was then added to 500 c.c. of distilled water, and the mixture was shaken frequently during two days. The precipitated resin was then filtered out, and after another smaller washing the watery solution was evaporated to dryness, and pretty

strongly heated. The solution thus evaporated was not entirely clear, and could not be renderd so by ordinary repeated filtration. The dried and heated residue was then boiled with repeated small quantities of distilled water and acetic acid, the solution filtered off and the washings continued until the filtrate measured 50 c.c. This liquid was transparent though not perfectly bright, and was of a light brown color, about the depth of light sherry wine. This solution was used for the qualitative testing. Ammonia added to a portion of it gave no discoverable blue tint. Sulphuretted hydrogen water when carefully added distinctly deepened the brown tint, but gave no precipitate on standing for 24 hours. Hager's test for traces of copper, by reduction upon a steel needle spirally wound with platinum wire and suspended in the acidulated solution by the wire, gave a very distinct film of copper both upon the needle and wire. By a series of checks made with this test at the same time, and with the same material, with known quantities of cupric sulphate added, it was found that this test was sensitive to 1 part of copper in 20,000 parts of solution. But the sensitiveness of the test varies very much with the quantity of the solution used, because in time it will reduce all the copper present in the solution whether that be 50 c.c. or 10 c.c. In this testing 20 c.c. was used for each trial, and when 1 milligramme of cupric sulphate, equal to about one-fourth of that quantity of metallic copper, was added to the 20 c.c. of solution, a fine uniform coating of metallic copper was obtained in 24 hours, leaving the solution free from copper.

These testings proved that copper was present in the extract, but showed that it was in very small proportion. A quantitative testing was then made.

Of the extract 1.850 grammes was carefully incinerated and the residue was carefully digested with hydrochloric acid and exhausted and washed with distilled water. This solution concentrated to about 10 c.c. was then reduced by metallic zinc, and the reduced copper was washed, dried and weighed. The quantity was so small that it could not be accurately weighed on the balance taken for the purpose, and the precautions necessary to weighing upon a finer balance involved so much time that it was not thought worth while where the weight was known to be less than half a milligramme.

If accepted as being half a milligramme, the proportion of copper would be 1 in 3,700 parts, or ·027 p.c. That is to say, each medium dose of 2 grains of the extract would contain ·00074 grain of cop-

per, an amount that is probably exceeded in the food of every meal of every-day life. Even the quantity of copper supposed by Mr. Maclagan to be present in some commercial extracts,—namely, one grain in 500 grains of extract, is probably inert, since in a 2 grain dose of such an extract there will be present only ·004 grain of copper.

Finally it was necessary to try the very definite statement that the extract "cannot be of a green color without being contaminated with copper." This statement might possibly be true notwithstanding all that has been shown in this paper, and is certainly not easy to disprove, because of the greater tendency to changes by heat, light, etc., of the green chlorophyll when managed in the thin layers of small quantites.

The fluid extract of which the extract is made by the process previously described is of a beautiful dark green color, with a yellow or orange tint. A portion of this was carefully tested for copper and gave no indications of the metal by the Hager reduction test, so that if it contains copper at all it cannot be in larger proportion than 1 part in about 20,000. Of this 100 c.c. was taken, and 85 c.c. of alcohol was distilled off from it by means of a glass retort with as little access of air as practicable, and a partial exclusion of light. The concentrated fluid extract, just thin enough to be poured, was transferred to a flat porcelain capsule. It was of a beautifully green color, not distinguishable from that of the fluid or solid extracts, and gave the same yellowish green tint to white paper. This extract weighed about 12.5 grammes and had to lose about 2.5 grammes to be reduced to the consistence of the solid extract. It was evaporated by a water-bath, but only the vapor of the boiling water was allowed contact with the capsule. The evaporation with constant stirring, required about 1½ hours, and the color was carefully watched at short intervals during the evaporation. A very slight change was noticed after the first hour, the green stain on white paper becoming perceptibly more yellowish, although the color of the green extract in the capsule showed no perceptible change. By the end of the evaporation this change in tint was considerably increased, but the extract in mass was still of a fine dark green color. When placed beside the original stock extract which contained the traces of copper, no difference in color was perceptible. Both were of so very dark a green that they appeared black or greenish black. At the thin edges against the white porcelain, however, there was a distinct differ-

ence in color, the experimental extract being still green, and not brown, but with a yellower or browner tinge, when closely compared with the other.

The difference in color was, however, not greater than might be expected from the exposure of the small portion to a higher temperature and larger air contact at that temperature, and the extract was not brown, but was dark green, though not as pure a green as the stock extract. As a check upon this management and conclusion, 10 grammes of the stock extract containing copper was taken in a similar capsule and was diluted first with a little alcohol, and then with 5 c.c. of water, and rubbed to a smooth mixture. The water at once developed a brown tinge, and this brown liquid portion was difficult to incorporate perfectly. The whole was then evaporated in exactly the same way and under the same conditions as the first portion. In an hour's stirring the tint had changed perceptibly, and in an hour and a half the evaporation was finished and the extract reduced to the original 10 grammes. The color of the extract was now distinctly more yellowish or brownish, but it was necessary to have both extracts in very thin strata and have them together to see the difference. Both were green,—not brown,—and when seen in mass and separately they appeared alike, yet when smeared upon white paper and put side by side, that with copper was decidedly the greenest of the two. This testing was very carefully done, and the conclusion from it is that the small amount of copper present has some influence in preventing or retarding the change of color in the green chlorophyll, but yet that an extract of cannabis indica can be of a green color without being contaminated with copper. The most that can be justly admitted is that the extract is of a greener color, or of a brighter and more intense green, when traces of copper are present than when the metal is absent.

Nevertheless this is not intended as a plea for copper, or for any other impurity in medicine or food. The copper should not be there if it can be prevented, and the writer proposes to gain by the experience above recited, to lessen the amount of copper in his extract, or perhaps exclude it altogether by the use of glass or porcelain surfaces from which to distill off the alcohol in making the extract.

But it has now been shown that Mr. Maclagan is in error in all the definite statements which he makes excepting the one which asserts the presence of copper, for copper is certainly present in this extract in an analytical sense, though not present in a proportion to be hurtful, and this latter is the sense taken by him. That is, a

deep green color is natural to any well made extract of Indian hemp when made from hemp tops of good quality; next, that such green color is not due to copper, and finally, that it can be of a green color without being contaminated with copper. His paper is therefore misleading to a rather unusual degree, and has done harm instead of the good it was intended to do.

THE PHARMACOPŒIA AND PHYSICIANS' PRESCRIPTIONS.

Prof. William P. Bolles, late of the Harvard Medical School and the Massachusetts College of Pharmacy, some months ago read a paper before one of the Boston Medical Societies, which, though never published, contained much that is of interest in regard to the materia medica.

As some points of Dr. Bolles' paper will be of use to this writer in reviewing the Pharmacopœia, permission was obtained to make use of them.

There are a great many articles in the Pharmacopœia that are of so little use to physicians that it has been supposed they might be dismissed with advantage, but it is very difficult to get trustworthy testimony on this point, and therefore they have been retained from one revision to another, and are growing more numerous; or at least articles are being gradually abandoned so that their numerical relation to the more important articles is becoming larger as therapeutic knowledge increases.

Dr. Bolles had the prescription files of three prominent pharmacists in different parts of the city of Boston examined and counted to ascertain the titles of officinal medicines which occurred on the prescriptions of physicians. The total number of physicians' prescriptions which were then analyzed and counted as representing the practice of the city of Boston was 3,726. The number of titles in the present revision of the Pharmacopœia is about 994. Of these titles 504 occurred in these 3,726 prescriptions.

Of the 504,	236	occurred	5 or more times.
	157	"	10 "
	80	"	25 "
	27	"	50 "
	9	"	100 "
	1	"	200 "

Sulphate of Quinine leads the list and is found in 292 of the 3,726 prescriptions. Sulphate of Morphia ranks next, and is found in 172 prescriptions. Bromide of Potassium in 171. Iodide of Potassium in 155. Tincture of Chloride of Iron in 134. Subnitrate of Bismuth in 133. Glycerin, and Syrup of Tolu in 120 each. Syrup in 108. Carbolic Acid in 92. Extract of Nux Vomica in 87. Camphorated Tincture of Opium in 80. Bicarbonate of Soda in 77. Calomel in 72. Chlorate of Potassium in 71. Compound Tincture of Gentian in 67. Lime Water in 65, and so on down. It will be thus seen that of the 994 articles of the Pharmacopœia only 17 occur more than 65 times in 3,726 prescriptions, and of these 17 three are vehicles or adjuvants which are in such common use as to bring their numbers into prominence.

But it is rather to those which are rarely used to which attention is drawn. It is to be regretted that the list did not embrace articles which occurred once or oftener, instead of 5 or more times. As it is, however, 490 titles, or nearly one-half, do not occur 5 or more times in 3,726 prescriptions, while 91 of the 504 titles which do occur are found only 10 times, or less than 10.

Dr. Bolles subsequently carried his investigations to about 10,000 prescriptions, but without altering the general results.

Now a medicine may be of primary importance and still not be wanted by physicians once in 700 prescriptions, yet the number of such must be so limited and the articles so easily recognized that they might be retained while others were dismissed.

It is, however, in duplicates and triplicates that the Pharmacopœia is most redundant, and in regard to these Dr. Bolles' lists give some interesting testimony. There is not a Decoction and but one Infusion in the entire 3,726 prescriptions, but Tinctures are still largely used where Fluid Extracts of the same drugs are accessible, while three Wines are still found among the low numbers of the lists. It is remarkable that the Fluid Extracts being so much the better and more accurate preparations do not more rapidly displace the Tinctures. The Fluid Extracts have almost entirely displaced the Decoctions, Infusions and Wines, and their advantages are such that their displacement of the Tinctures, with their large doses, large proportion of alcohol, and uncertain composition, is only a question of time. There is probably not a single drug the original use of which was in the form of a fluid extract that ever afterward came into use either as a decoction, infusion, spirit, tincture, or wine, and this is but a natural progress, since a well made fluid ex-

tract is all that is needed and fulfills the role of all others better than they do.

If the Pharmacopœia has the crude drug as a material, and for the purpose of definition, description and tests, and then has a fluid extract of it, nothing more is needed, nor is really useful except in the comparatively few instances in which a solid extract is convenient and serviceable.

To have any drug,—as in the case of Digitalis,—in substance, in Abstract, in Decoction, Infusion, Extract, Fluid Extract and Tincture is certainly surplussage of a very useless kind; and there is no more reason for it than for the other two possibilities, namely, a Syrup and a Wine. In this list of 3,726 prescriptions Digitalis occurs 10 times as powder, 5 times as Infusion, and 34 times as Tincture, but in no other form, while the uses of the drug would have been better accomplished by the Fluid Extract in any supposable case whether used alone or in combination. The individual habits of physicians are the cause of much of this surplussage, and the pharmacist who keeps himself in readiness to supply all these forms of every drug, has his shelves overloaded and cannot possibly have all the forms of proper freshness and in proper condition for use. The individual preferences of physicians are largely prejudices adopted from teachers in the schools, and therefore if the schools would but reason upon the subject and direct only the best preparation of each drug, a needed reform in the Pharmacopœia would soon follow, and the pharmacists' supplies would be much fresher and more trustworthy. As it is, that physician is always safest who orders his drugs in the forms which are best made and which keep best, and which are in most general use, so that the supplies may be in the freshest condition, and all these conditions are best fulfilled by the fluid extracts. That so many physicians are doing this is probably the reason why tinctures are so rapidly following the decoctions, infusions and wines out of use with those in this country, who think most about their materia medica. In England and France, where progress is sometimes looked upon with conservative suspicion, the decoctions, infusions, syrups, wines and tinctures fall into disuse much more slowly, and large nauseous doses seem to be much less objectionable.

Accuracy and uniformity in strength being of the first importance in the materia medica, while liability to change by keeping being the prominent thing to be avoided, each physician can easily select that preparation of each drug which best meets these indications.

METALLIC BISMUTH.

Some recent, sudden and great fluctuations in the price of bismuth led to the hope of lower prices, but still more recent changes have not only not sustained the expectation, but have been in the direction of advanced price. Up to June last the supply has been abundant at about $1.80 per pound, or about 6 shillings and 8 pence in the London market, where this interest is centred and mainly controlled. During June it was reported that on July 1st there would be a reduction in price to 4 shillings and 6 pence, and on August 1st to 2 shillings and 6 pence, equivalent to prices of about $1.25 and 75 c. in the New York market. Small quantities were sold in London and here at the first reduction, but when August came the second reduction did not take place, but instead of that a sharp advance occurred to $1.50 and $1.60, and these prices have been maintained in this market, and the metal has been scarce and hard to get at the prices.

Bismuth is a metal of limited production, although new sources of it are not unfrequently announced; and some of these new sources are in this country. The general process for separating it is neither difficult nor expensive, but as the metal is used in comparatively small quantity there has not been much inducement for capitalists, in its production. This perhaps, rather than any scarcity of the ores yielding it, has made it always a high-priced metal, and probably one which yielded large profits.

Some years ago it was supplied almost exclusively from Saxony, and the competition between the Saxon sources of supply, together with the limited demand, kept the prices within certain limits. For example, in 1859 and 1860, the prices here were about $1.20 to $1.35. In 1861 there was a steady rise in price, until by the end of the year it reached $2.50. During 1862 it continued to rise and reached $7.00. In 1863 the price receded and $4.50 to $5.00 was about the rule. In 1864 and 1865 it varied between $5.75 and $6.50, and throughout 1866, 1867, and a part of 1868 the writer's purchases ranged between $4.75 and $8.00 as the extremes, the latter price being for only a short time in 1868. In 1869 a gradual decline in price set in and continued. In 1869, the prices ran from $5.75 to $5.50. In 1870, from $4.50 to $3.65. In 1871, from $3.85 to $3.60. In 1872, from $3.25 to $2.85. In 1873, from $2.70 to $2.35. In 1874, from $2.30 to $1.85. In 1875, the price was $1.75 throughout the year. In 1876 and 1877 it was $1.72, advancing to $1.80 at

the end of 1877. In 1878 and 1879 the range was back and forward between $1.85 and $1.78. In 1879 and 1880 the variations were between $1.85 and $1.80; and since 1880 the price up to June last has been about $1.80.

The prices in this market from about 1861 to about 1874 were, of course, fictitious. That is, it was not so much a rise in the price of bismuth as a fall in the purchasing power of the currency. Nevertheless, the rise in price was generally far greater than it should have been in relation to the price of gold, since gold never went above $2.80, while bismuth advanced far beyond that, showing the tendency of trade to take advantage of an unstable currency.

During the latter portion of this period of 25 years a new source of supply of bismuth was opened. It had long been known that there were rich deposits of bismuth ore in Bolivia, but they were not developed until about the time mentioned, and when this Bolivian metal first appeared in London there was a sharp decline in price. This reduction was, however, of short duration, and when the price again advanced all buyers were required to take about half of each purchase of the Bolivian metal. This at once led to the inference that the old source of supply had bought up the new one, or that a pool had been formed in the interest of price;—the various Saxon interests having been supposed to have been previously pooled in the same interests of maintaining prices against the consumers. This condition of the market was maintained for several years, during which time there were occasional reports of bismuth from a new source in Australia, and small lots of metal from this source were occasionally found in the London market, either extracted in Australia, or in England from Australian ores. But the quantities were not such as to disturb the market or render the old monoply uneasy. It is understood, or inferred, however, that about June last considerable quantities of Australian bismuth were either actually received, or were available for the London market, and it is inferred that this was the reason for the great and sudden reduction of price, because this is about the mercantile way in which the owners of a monoply would be likely to say to a new source of supply of their article: "What are you going to do about it? Are you going to sell out to us, or join us? or shall we undersell you till you stop?" There is, of course, no way of getting at the facts in such cases, because all such dealings are conducted with great caution and privacy, and any attempts to investigate them would be either resented as impertinent, or be met by statements intended to mislead inquirers, so

that the above inference is merely an imaginary interpretation of the conditions of the market. If the interpretation be correct it seems now to be probable that the new Australian interest has replied to the old—"We will join you if you will give us an equitable share of the profits." Then the danger to the combination will be that the three sources of supply where there only used to be one, will overstock the market and there may not be sale for the total product, and either the amount produced will have to be controlled, or a danger incurred that some member of the syndicate will undersell his obligations in some private way, so as to utilize his production, and realize his profit.

There will probably be difficulty in keeping a harmonious action between sources of supply so widely separated, and it is probable that the only hope of lower prices lies in the failure of some one or more of the parties to keep faith with the others. At least this is the general history of such combinations.

If the price was at once reduced to such as would yield a simple liberal manufacturer's profit, it would in all probability be not over 75 to 80 cents per pound, and this would take the embargo off of a great number of uses of the metal in the arts and manufactures, and soon lead to the use of all that could be produced. For example, the stereotyping for temporary work might be cheapened and advanced very largely if bismuth was cheap enough to be largely used in the alloys of printers.

The uses of bismuth in medicine have increased very rapidly within the past few years, and that not from any fashion or fancy, but from a gradual and sound recognition of its true value, and therefore a more reasonable price for the metal is an important matter from a medical point of view.

THE PHARMACOPŒIA OF 1880.

(Review Continued.)

ALCOHOL DILUTUM.

DILUTED ALCOHOL.

A liquid composed of 45.5 per cent. by weight (53 per cent. by volume) of Ethyl Alcohol, and 54.5 per cent. by weight (47 per cent. by volume) of Water. Sp. gr. 0.928 at 15.6° C. (60° F.), and 0.920 at 25° C. (77° F.).

Alcohol, *fifty parts*	50
Distilled Water, *fifty parts*	50
To make *one hundred parts*	100

Diluted Alcohol of this strength may be prepared from Alcohol of any higher percentage by the following rule, in which all terms denote weight:

Divide the alcoholic percentage of the Alcohol to be diluted, by 45.5, and subtract 1 from the quotient. This gives the number of parts of Water to be added to *one* (1) *part* of the Alcohol.

Diluted Alcohol should respond to the tests of purity given under *Alcohol*.

It is of much more importance than is generally supposed to have this Diluted Alcohol of a definite and proper strength. Both physicians and pharmacists necessarily depend largely upon it as both menstruum and vehicle, and without thinking how much often depends upon its being pretty accurately of the prescribed strength, they disregard the strength and have as a result imperfect preparations. Hardly anything in the materia medica is more frequently mismanaged,—or so loosely managed, and with bad results that are not commonly attributed to the right cause. The common practice is to take half alcohol and half water, and this generally by measure, and frequently without knowing the strength of the alcohol.

It seems trite to say that alcohol should never be used without knowing that it is of the proper strength, yet it is very commonly so used, and then of course the strength of Diluted Alcohol made from it cannot be known, and uncertainty is introduced into all the uses of both.

A specific gravity hydrometer is indispensable to the physician who prepares or tests any of his liquids, and to the pharmacist of course. The instrument is not susceptible of great accuracy, and therefore need not be applied with great accuracy, either as to the reading or the temperature, and being tolerably correct to start with, and then being used rapidly, it takes but little time, and gives approximate results that would be a great improvement on the common practice without it. Every parcel of alcohol bought should be tried with either the hydrometer or the s.g. bottle, and a note of the strength made on the label of the package. It will generally be found to be between ·819 and ·824 at 15.6° C.=60° F., usually about ·822, and if it be as weak as this, and the Diluted Alcohol be made from it by taking equal weights of this and of water, the Diluted Alcohol will be much too weak. That is, the departure from the required strength will be much greater in the

Diluted Alcohol than in the strong alcohol from which it was made, because the excess of water present in the original alcohol taken is doubled in the dilution.

In order to make the Diluted Alcohol more constant in strength, irrespective of the strength of the alcohol from which it is made, this revision of the Pharmacopœia gives a very simple and convenient rule for diluting any greater strength of alcohol down to the required 45.5 p.c. ; but it is the application of such rules as this to the use of parts by weight that make the latter a stumbling block to many, and therefore a few words of explanation of this rule may be warranted.

Suppose the pharmacist is in the habit yet of dealing with this liquid by measure and wants to make 4 pints of it, from an alcohol which he finds to be s.g. ·824. As the s.g. of Diluted Alcohol is ·920, the 4 pints of it will weigh about 3.83 pounds.

Turning to the Alcohol Table he finds that alcohol of the s.g. ·824 contains 89.54 p.c. of absolute alcohol by weight. He then applies the rule by dividing 89.54 by 45.5 and gets 1.968 for the quotient ; subtract 1 from this and ·968 is left as the fraction of a part of water to be added to each part by weight of the ·824 alcohol.

He now takes, in a tared 4 pint bottle, 2 pounds of this ·824 alcohol, and this is 32 ounces, or 14,000 grains. Now the relative term "parts" in the formula may be construed as pounds, or ounces, or grains ;—that is, 2 parts, or 32 parts, or 14,000 parts,—but the latter is the best, because it gives the result in grains, while the others give their results in decimal fractions of pounds or ounces which are less easily converted into arbitrary weights. Now if each 1 part of the ·824 alcohol requires ·968 part of water, these 14,000 parts will require 14,000 times ·968 part, or (14,000 × ·968 =) 13552.000 parts of water. Then the 14,000 grains of the alcohol will require 13,552 grains of water in order to yield the officinal Diluted Alcohol, and this is 448 grains, or a little more than an avoirdupois ounce, less than 2 pounds. The Diluted Alcohol will then weigh (14,000 + 13.552 =) 27.552 grains, or 3 pounds 14 ounces and 427 grains, which is a very little over the 4 pints which he started to make.

Now suppose the Pharmacopœia had given this rule by an arbitrary standard. It would simply have said, "This gives the number of pounds of water to be added to one pound of the alcohol." The necessary calculation would have been exactly the same in that case, and with these calculations it would have fitted

this example just as well, but it would not have applied equally well to a barrel of alcohol or to five gallons. Each physician and pharmacist must have a rule of quantity upon the scale of his own wants, and the term "parts" is the only one that applies equally well to all quantities, large and small, and yet keeps the relations between the ingredients always the same, and always accurate, no matter what system of arbitrary weights may be used. If the metric system of weights be used, however, the calculations are far more simple and easy.

ALLIUM.

GARLIC.

The bulb of *Allium sativum* Linné (Nat. Ord., *Liliaceæ*).

Bulb subglobular, compound, consisting of about eight compressed, wedge-shaped bulblets, which are arranged in a circle around the base of the stem, and covered by several dry, membranaceous scales. It has a pungent, disagreeable odor, and a warm, acrid taste. It should be preserved in a dry place, and used only in the fresh state.

Preparation: Syrupus Allii.

This substance might have been usefully dismissed from the Pharmacopœia thirty years ago. The writer has had the satisfaction of voting against it twice in Committee of Revision, and now out of the committee, again votes against it with unwavering prejudice and obstinacy.

The present committee has for the first time dignified it with a somewhat scientific description, which ends in a rather funny way. It should be preserved in a dry place, only that it is not to be preserved at all, but be used in the fresh state.

The meaning of course is that it should not be dried, but how the drying is to be prevented in a dry place is not mentioned.

Now that it is also farther dignified by having a syrup made from it, there is no knowing how much longer it will live.

ALOE.

ALOES.

[ALOE SOCOTRINA, *Pharm.*, 1870.]

The inspissated juice of the leaves of *Aloe socotrina* Lamarck (Nat. Ord., *Liliaceæ*).

In hard masses, occasionally soft in the interior, opaque, yellowish-brown or orange-brown, not greenish, translucent on the edges; fracture resinous, somewhat conchoidal; when breathed upon, it emits a fragrant, saffron-like odor; taste strongly bitter. It is almost entirely soluble in alcohol and in 4 times its

weight of boiling water. Mixed with alcohol and examined under the microscope, it exhibits numerous crystals.

Preparations: Aloe Purificata. Extractum Aloes Aquosum.

The above definition is much more definite than the present state of knowledge will justify. Or rather the present state of want of definite knowledge simply makes it almost certain that several species and numerous varieties and hybrids yield the kind of aloes which is intended to be made officinal. That kind known in the best markets as Socotrine Aloes is what the Pharmacopœia directs, and its definition is intended to exclude the kinds known as Cape, Barbadoes, Curaçoa, and indeed all other aloes, from pharmacopœial uses. This is a very proper distinction, because it is based on the therapeutic effects; and the therapeutic effects of this kind of aloes are probably due quite as much to the mode of preparation as to the variety of the aloe plant which may yield it. Climate and locality has doubtless much to do with the quality of the aloes of the markets, and there is almost as much difference in quality in different lots of socotrine aloes as there is difference in kind between Cape, Barbadoes and Curaçoa. The broad general fact is that the aloes which reaches the markets from Bombay, Muscat, Aden, Zanzibar and other shipping ports and places of production embraced within the range from Bombay to Zanzibar, are all called socotrine aloes. The island of Socotra lies about midway of this range, but probably yields a very small proportion of the aloes;—and there is even some doubt, according to Bentley and Trimen, whether this island really gave the name to this kind of aloes, or to the species of plant supposed to yield it. These excellent authorities call the species "Aloe succotrina," quoting "Aloe succotrinum" as the name of this drug used in the tenth century, which name C. Bauhin derives from succus citrinus, or yellow juice. They, however, state that succotrina "is more probably a corruption of socotorina, or socotrina from the island."

The other general class or kind of aloes of the markets comes principally from Southren Africa and the West India islands.

There is a broad general difference in the mode of preparation of these two classes or kinds of aloes, and quite as broad a difference in therapeutic action, and it is highly probable that this latter difference is due as much to the mode of preparation as to the species of plant yielding it, or to climate, soil, etc. The East Indian aloes is comparatively mild and gentle in operation, requiring larger doses, and is tonic and stomachic in local and general effects.

The south African and West Indian aloes is more active and prompt in smaller doses, and is often drastic and irritant, causing more griping in its action and leaving a local and general atonic condition. The first kind, or socotrine aloes, is alone adapted to human beings, whilst the other kinds are much better adapted to veterinary uses.

The broad distinction in the mode of preparation is that the East Indian kinds are all inspissated or concentrated from the juice as it exuded, by exposure to the heat of the sun, and as the plant itself elaborates its juices in this heat, the exuded juices are but slightly changed by it otherwise than to lose water, and acquire greater consistence. And these juices reach the markets in almost all grades of consistence, from that of syrup, to that of a brittle solid. Of late years the liquid and semi-liquid consistence are more rarely met with, the condition of a nearly brittle solid in cold weather, and of a soft solid in hot weather, being more common with the best qualities. Toward the centre of the packages,—or throughout if in tin cases,—the aloes is a soft solid, or a scarcely movable liquid.

The aloes from southern Africa and the West Indies, and all the kinds excluded by the Pharmacopœia, are inspissated by boiling, and this boiling down of the juices is generally done in a rude and careless way, often with a very prolonged application of the heat, and the heating badly regulated.

Of late years small specimens are occasionally seen of West India aloes which have been inspissated by the sun, or by some gentle, well regulated method of heating, and such specimens have all the characteristics of very fine aloes, and the therapeutic action is said to be mild and pleasant, but the odor is still very different from that of East Indian aloes.

As an incidental disadvantage from the Eastern method of inspissating the aloe juice it always contains a much larger proportion of foreign matters, such as sand, shreds of aloe plant, splinters of various kinds and sizes, nails, bits of leather, and even the rude implements used for cutting the leaves. The writer once had quite a museum of such odds and ends taken from this aloes by straining. Exposed to the sun in shallow excavations dug in the sand and lined with goat-skins, the blowing in of sand, shreds, etc., to a limited extent is unavoidable, but the proportion varies so much as to leave room for inference that the quantity is often intentional.

This kind of aloes reaches this market in barrels, kegs, tubs and

boxes. Barrels, kegs and tubs are now becoming more and more rare, these packages belonging to the past times when it came in a more liquid condition. Although kegs of semi-liquid aloes are still not uncommon, four-fifths of that seen by the writer within the past three or four years, has been in cases about the size and shape of claret cases. Occasionally when the aloes is hard, it is found to have been poured directly into the wooden case. But when of the more common consistence this would gradually leak through the joints of the cases in the long transportation through the tropics, and therefore, as a common rule, the claret cases are tin-lined and soldered, and the getting of the aloes out of these is a matter of difficulty and loss.

The officinal description of this East Indian or socotrine aloes does not accord with the writer's experience of the best qualities that are always easily attainable with care in selecting and with price a secondary object.

The consistence differs so much that any definite description must fail, but the aloes is rather translucent than "opaque;" and although "yellowish-brown or orange-brown," are properly descriptive of a large proportion, an orange-ruby-red, or a reddish-black in masses, is the color of the better parcels; always "translucent on the edges," and the nearer the transmitted light is to a ruby-red, the better the aloes. This last critical test is equally applicable in the soft state, for then the aloes can be pulled out into a thin film, and the transmitted light will be yellow, orange, or red, and the prevalence of the red tints will generally indicate the finer kinds. But in some parcels where the orange, or even the yellow prevails in the soft state, if the sample be pulled out into thin lamina and be allowed to dry for a day or so, the color may change to ruby-red. This circumstance is very useful in selection, because when the tin case of the soft aloes has been standing open for a few days for the inspection of buyers, there will be threads and thin lamina about the opening which have become dry, and have assumed the final color. If this color be red, and the portions be translucent, such a package may generally be accepted as red socotrine aloes; and this the writer regards as the best quality. When such aloes becomes dry and is in hard masses, it is of a reddish-black color, free from yellow or green tinge, and breaks rather easily, the facets of fracture being small and glassy, and of that kind of a black which is the utmost concentration of ruby-red. In this fracture air cavities are very numerous, so as to render the mass almost spongy at times, and

particles of foreign matters are not rare. A resinous and conchoidal fracture are never met with in the writer's experience with socotrine aloes, but are characteristic of the other kinds of aloes which are boiled down. The odor of socotrine aloes is characteristic, but to the writer indescribable. To him it is never "saffron-like," and never fragrant in the sense of a sweet or pleasant smell or a perfume. At its best it is not disagreeable, but perhaps rather agreeable, but very often, if not commonly, it has an element of disagreeable sourness, suggestive of decomposing vegetable juices, and such decomposition is probably its source. This sourish smell, in the London market, seems to condemn some of the very finest of this kind of aloes. At least the writer has not unfrequently bought very fine parcels, said to have been rejected in London on account of this odor. Such aloes has always lost this odor entirely in the process of straining, yielding a very fine purified aloes for powdering. As stated "it is almost entirely soluble in alcohol," but the statement that it is soluble "in 4 times its weight of boiling water," is an error, and in view of its composition the two statements are incompatible.

The aloes is entirely soluble in either Alcohol or Diluted Alcohol when a small quantity in powder is added to a large quantity of the liquid, the impurities of the aloes only settling out. But these impurities are always seen, and are generally seen in considerable proportion, even in the purified aloes. One part of water will dissolve by heat in about five parts of aloes,—that is, they melt together so as not to separate afterward, but it was tried in vain to dissolve the powdered aloes in any proportion of boiling water up to 10 times its weight. This solubility in water is therefore, as a test, very misleading, and it seems probable that it is a mistake which has somehow crept into the paragraph of tests. In a hot solution of soap and water the aloes is quite soluble, as are many resinous substances.

Aloes is rarely seen by the physician or pharmacist in any other condition than that of powder, as it is almost universally bought in powder from the wholesale dealer or drug-miller. Hence the pharmacopœial description of it in masses is not of great importance except to those who have it powdered, and there is good reason to believe that these disregard the description, and too often have it powdered without straining.

Some description and tests for powdered aloes are therefore much needed, and these will be attempted under the next head of Purified Aloes.

A more extended note upon officinal aloes, by this writer, may be found in the Proceedings of The American Pharmaceutical Association for 1872, vol. 20, p. 236.

ALOE PURIFICATA.

PURIFIED ALOES.

Aloes, *one hundred parts* 100
Alcohol, *fifteen parts* 15

Heat the Aloes, by means of a water-bath, until it is completely melted. Then add the Alcohol, and, having stirred the mixture thoroughly, strain it through a fine sieve, which has just been dipped into boiling water. Evaporate the strained mixture by means of a water-bath, constantly stirring, until a thread of the mass becomes brittle on cooling. Lastly, break the product, when cold, into pieces of a convenient size, and keep it in well-stopped bottles.

Purified Aloes is in irregular, brittle pieces of a dull brown or reddish-brown color, and having the peculiar, aromatic odor of Socotrine Aloes. It is almost entirely soluble in alcohol.

Preparations: Pilulæ Aloes. Pilulæ Aloes et Asafœtidæ. Pilulæ Aloes et Ferri. Pilulæ Aloes et Mastiches. Pilulæ Aloes et Myrrhæ. Tinctura Aloes. Tinctura Aloes et Myrrhæ. Vinum Aloes.

This preparation was introduced in the revision of 1860, and the other surviving active member of that Committee of Revision will remember what a struggle the writer had to procure its adoption. His museum of curiosities obtained from this aloes and his many years of statistics of the proportion of foreign matters taken out of it, were not convincing until a member of the committee was commissioned to buy a keg of socotrine aloes in the Philadelphia market, have it strained and present the results. The aloes of the markets has improved much since that time, and rare parcels of it are now met with which do not require straining, but as a rule the process should never be omitted. There is no doubt that the process injures the aloes somewhat by the heating, and as knowledge increases in the countries where it is produced, the inducement of higher prices for a better article may yield it to those who are willing to pay for it, and thus save the cost of the straining process.

In alcohol, labor, skill and apparatus, the straining process cannot cost less than about 10 to 12 cents per pound, which sum added to the price at the place of production would pay twice over for the care necessary to keep the juice clean during inspissation. The above formula and process were contributed by the writer in 1860, after having been practiced for several years, and they are defective only in one important detail, and that is to direct how fine the "fine sieve" should be. As it stands this is much too indefinite.

Through a sieve of 80 meshes to the linear inch, the aloes will not pass with the prescribed dilution, while with a No. 40 sieve too much of the sand will pass. The sand in the aloes being mainly that which is drifted by light winds, is very fine, so that a certain portion of it will pass through almost any sieve, but for practical purposes a No. 60 sieve accomplishes a very good purpose, and takes out all but a small and harmless portion of very fine sand. The proportion of this should, however, be limited by the following simple test which should be applied to all powdered aloes before it be admitted to use.

Dissolve 5 grammes or 77.16 grains of the powdered aloes to be tested in 50 c.c. or 1.66 fluidounces of Diluted Alcohol,—filter the solution off through a tared filter wetted with Diluted Alcohol,—wash the filter and the residue upon it with Alcohol, until the washings pass colorless, and then dry and weigh them. Subtract the weight of the filter and multiply the weight of the residue by 20. The product will be the percentage of the residue.

If the aloes has been dried and powdered without having been strained the residue will amount to over 5 p.c., generally to 6 or 7 p.c., even when the aloes was of good quality. If the straining has been by too coarse a sieve the residue may reach 3 to 4 p.c. But if through a No. 60 sieve about 2.5 p.c. may be expected.

This residue is partly dust, very fine sand, ground still finer by the mill in powdering, and the detritus of the mill stones; but beside there is a considerable and variable proportion of that kind of vegetable derivative called by Berzelius apothem,—an oxidised extractive matter, largely a result of the heating process. This is tasteless, insoluble and inert, and is neither aloes nor the result of the decomposition of aloes. Roughly estimated, this organic matter in the residues by the above given process of testing, appeared to constitute from 1.5 to 2 p.c. of the powdered aloes, thus reducing the above given percentage as found to about 1 to 1.5 p.c. of foreign matters in the residue from properly purified and powdered socotrine aloes of good quality; or, if less effectually strained, to 1.5 to 2.5 p.c., thus agreeing fairly well with the figures given for the straining process on the large scale, as this does not take out the apothem.

A powdered socotrine aloes of good quality, which, by the above test, does not give over 3.5 p.c. residue, including apothem, leaves no therapeutic reason or use for any of the extracts of aloes, nor for aloin. These may be good substitutes for poor aloes, but not for good aloes.

The amount of impurities strained out of the best grades of socotrine aloes varies very much; and so does the proportion of water contained in such aloes in drying it for powdering. The writer has a record upon these two points which extends over more than 30 years of practice.

During the five years from 1865 to 1869 inclusive, the writer purified and dried for powdering by the above process 208 packages of socotrine aloes, namely, 18 barrels, 65 kegs, 7 tubs, and 118 boxes, containing a total of 21,675 pounds.

From this the residue obtained by straining was 1,163 pounds, or 5.36 + p.c. The additional loss of water by drying was 2,362 pounds, or 10.9 — p.c., making a total loss of 16.26 p.c. The maximum loss by straining was about 16 p.c. on several lots, and in a few instances the loss fell to about 2 p.c. The loss by drying varied between 22.1 p.c. on one lot of 3 barrels of liquid aloes, and 7 p.c. on a very few boxes without tin linings.

During 1883 and to the present time in 1884, about 2,111 pounds have been purified and dried, and although the notes are imperfect they indicate a loss by impurities of 5.38 + p.c., and by moisture of 14.47 + p.c., making a total of 19.85 + p.c.

These figures show that although the amount of impurities strained out is about the same as 15 years ago, the amount of moisture has increased considerably, thus increasing the total from 16.26 p.c. to 19.85 p.c.

The powder from purified aloes is brighter in color than when made from the same aloes before purification, but the color of the powder varies much in different parcels, giving no important information as to value. It is always of a dull or tawny yellow color, and the best varieties have an orange or reddish tinge.

Aloes though rarely or never used alone, is a very valuable therapeutic agent. Dr. Thomas Hewson, one of the eminent men of a past generation in Philadelphia, and one of the best therapeutists of his day or any day since, was wont to say to his pupils that when they became practitioners, their skill might be measured by their knowledge of good aloes and how to use it, and this especially in the disorders of females. Few drugs are susceptible of more varied and beneficent uses, while the better grades are but little liable to over action. Always given in combination it yet always acts a principal part. Combined with aromatic powder and soap to render it soluble, especially when given in loose powder, in capsules or wafers, its gentle and tonic action as an aperient is upon the

whole alimentary tract, gently stimulating the action of adjacent glands. When its action on the upper part of the canal is to be emphasized, the addition of a small quantity of calomel or resin of podophyllum is commonly advisable. When the whole tract is to be equally impressed it is often combined with senna or colocynth, —the former in females, the latter in robust males.

When the lower or large intestine is to be impressed without disturbing the upper part of the tract, it is best combined with some resin, as mastic or myrrh, in the form of pill. Its solubility is then retarded and so modified that the action can be made to reach the lower bowel especially. Whilst podophyllum, taraxicum and several other agents affect, by a kind of election, the upper part of the canal, and whilst rhubarb, senna and other agents affect prominently the small intestine, aloes is almost the only agent which can be so guarded and guided by skill, as to affect prominently the large intestine by this same kind of election. And as the large intestine is that part of the canal where torpidity usually commences, and where it is most persistent; and that part too, which when obstructed or impacted, obstructs every viscus above it, it is very important to have an agent which when of good quality and directed by skillful hands may prove a true remedy. It is often said that aloes irritates the rectum, and should never be given when there are hemorrhoids or a tendency to them. But it is probably the prescriber that irritates the rectum by the misuse of aloes, or by the use of the wrong kind of aloes, and by unskillfully adjusted doses. When skillfully used it is highly probable that good aloes never produces griping. Persons are differently susceptible to aloes, as to medicines in general, and the only use in naming a dose is to know what quantity to begin with. About 2 grains of aloes in judicious combination with small quantities of other purgative agents is often sufficient to give the aloetic impression or direction. The officinal pills of aloes, and of aloes and mastic, each contain 2 grains each of aloes, and a single pill repeated at moderate intervals, will often yield the required effect. But the use of aloes cannot be learned from arbitrary doses, because a variation of dose is often the difference between its successful and unsuccessful use, and sometimes 10 grains may be required.

The Barbadoes Aloes and Cape Aloes of former revisions are very properly dismissed from the Pharmacopœia, for, as before noticed, they are not well adapted to pharmacopœial uses, and introduce differences in dose and effect which are, to say the least, confusing.

Aloin has very properly been passed without recognition by the Pharmacopœia. It probably possesses no single advantage over

good aloes, and is one of the fashions in the materia medica which seems to be gradually dying out.

In connection with aloin and its uncertainties it is a very curious and significant circumstance that it varies in ultimate composition as derived from the various kinds of aloes; and the different kinds of aloin vary as much from each other as do the alkaloids of cinchona barks. It is, therefore, hardly within the range of probability that the various aloins are alike in therapeutic effect; and it is no more probable that their effect when separated, as aloins, are the same as when used in the natural combinations as aloes.

ALTHÆA. MARSHMALLOW. This is another title that might well have been dropped from the Pharmacopœia many years ago. As a simple demulcent it may not be entirely useless, even though without medicinal effect. But whether as a demulcent or vehicle, it has so many superior substitutes, that it has gradually fallen into disuse at least in this country. It is not only continued in this revision, but a useless Syrup of Althæa has been introduced, thus still farther increasing the surplussage.

ALUMEN.

ALUM.

$K_2Al_2(SO_4)_4.24H_2O$; 948.—$KO,SO_3.Al_2O_3,3SO_3.24HO$; 474. [ALUMINII ET POTASSII SULPHAS, *Pharm.*, 1870. POTASSA ALUM.]

Large, colorless, octahedral crystals, sometimes modified by cubes, acquiring a whitish coating on exposure to air, odorless, having a sweetish, astringent taste and an acid reaction. Soluble in 10.5 parts of water at 15° C. (59° F.), and in 0.3 part of boiling water; insoluble in alcohol. When gradually heated, the salt loses water; at 92° C. (197.6° F.) it melts, and if the heat be gradually increased to 200° C. (392° F.), it loses 45.57 per cent. of its weight (water of crystallization), leaving a bulky, white residue. The aqueous solution of the salt dissolves zinc and iron with evolution of hydrogen. Water of ammonia produces a bulky, white precipitate, which is nearly insoluble in an excess of ammonia.

With solution of potassa or of soda, Alum yields a white precipitate which is completely soluble in an excess of the alkali, no odor of ammonia being evolved (difference from, and absence of ammonia-alum). The clear alkaline solution should yield no precipitate with test-solution of sulphide of ammonium (zinc or lead). A solution of 1 Gm. of Alum in 30 C.c. of water should not assume more than a bluish coloration on the addition of a drop of test-solution of ferrocyanide of potassium (limit of iron).

Preparation: Alumen Exsiccatum.

In the last revision of the Pharmacopœia the titles Alumen, Alum, were taken from the Alum upon which all therapeutic uses of the salt were based, and were applied to ammonia alum, while the old potassa alum was given a new title, namely, Sulphate of Aluminium and Potassium. This change was promptly and seriously criticised at the time, and was soon shown to be a very unwise

change. The present Committee of Revision has very wisely reconsidered and reversed this change, dropping the ammonia alum altogether, and restoring the title to potassa alum, as it was in the preceding revisions, and after the confusion caused by these changes shall have been lived down the kind of alum most appropriate to therapeutic uses will again be better recognized.

The above definition, description and tests being very full and definite will aid much in overcoming this confusion, but it must still be remembered that the form of crystals, the taste, solubility, and many other of the physical and chemical properties, are practically the same for the two alums. Perhaps the simplest and most readily applied test to distinguish between potassa and ammonia alums is to rub the sample in a mortar with a little lime, when if ammonia be present it will be easily recognized by the odor.

These alums are illustrative of how price rules almost every thing. Formerly the word Alum meant potassa alum, and nothing else. When ammoniacal gas liquors became cheap and plentiful, ammonia was substituted for potassa in alum, cheapening the price. Then potassa alum was rapidly crowded out of the markets, and it was difficult to get. Later, when the potassa deposits of Strassfurt were opened, making potassa salts very cheap, while ammonia salts, from being largely used in fertilizers, were not farther cheapened,—potassa alum could be again made so as to undersell the ammonia alum, and consequently it is now coming into use again, and is very plentiful. It is probable that thousands of people have gone on using alum throughout these changes without knowing that they were using different salts at different times, but only knowing that their alum worked better sometimes than at others.

The officinal potassa alum as met with in the markets, is not in the best condition for medicinal uses. It is commonly unclean, and contains a considerable proportion of free acid and concentrated mother liquor. Being an acid salt when pure, the excess of acid present in the commercial article cannot be easily judged by the acid reaction. Under these circumstances it is always the best practice to purify that which is for medicinal use.

This purification is simple and easy, and any one can do it for himself. The commercial alum is simply dissolved in twice to three times its weight of hot distilled water,—the hot solution filtered through paper, and the filtered solution stirred frequently while cooling, so that the salt crystallizes in small granular crystals. These crystals are drained in a funnel and then percolated with about half their volume of distilled water put on drop by drop over the surface, so as to displace the mother liquor. The crystals,

when again well drained, are spread upon bibulous paper and dried without heat, protected from dust.

An additional quantity of crystals may be obtained by evaporating the mother liquor and washings, but they are not as nice as the first, and as the salt is a cheap one, it is more economical to throw the residues away when small quantities only are purified. When thus treated it constitutes the purified and granulated alum for medicinal uses, but this should not be confounded with a granulated potassa alum which is put into the market in large quantities by the manufacturers, and which is less pure than the alum "in lump" or in large crystals.

For internal administration this alum should always be used in fine powder, the granular form answering very well for solutions.

The purified and granulated alum is a very important medicinal agent. As a prompt emetic, neither preceded nor followed by depressing nausea, it has probably few equals, and hence its common use in the spasmodic croup of children. As an astringent or hæmostatic in internal hemorrhages it is also very prompt and efficient. Applied locally in solution it is one of the best cleansing astringent and disinfectant applications that can be made, and hence its common use as a standard substance for gargles, injections and washes. The common emetic dose for children is a teaspoonful of the powder, it not being necessary to weigh it, and it is, perhaps, best given in a tablespoonful of powdered sugar and water. The dose to commence with, for internal uses, is 10 to 20 grains.

ALUMEN EXSICCATUM.

DRIED ALUM.

$K_2Al_2(SO_4)_4$; 516. —$KO,SO_3.Al_2O_3,3SO_3$; 258.

Alum, in small pieces, *one hundred and eighty-four parts*..... 184

To make *one hundred parts*..... 100

Expose the Alum for several days to a temperature of about 80°C. (176° F.) until it has thoroughly effloresced. Then place in a porcelain capsule, and gradually heat it to a temperature of 200° C. (392° F.), being careful not to allow the heat to rise above 205° C. (401° F.). Continue heating at the beforementioned temperature until the mass becomes white and porous, and weighs *one hundred* (100) *parts*.

When cold, reduce it to a fine powder, and preserve it in well-stopped bottles.

A white, granular powder, attracting moisture when exposed to the air, odorless, having a sweetish, astringent taste, very slowly but completely soluble in 20 parts of water at 15° C. (59° F.), and quickly soluble in 0.7 part of boiling water. It answers to the same reactions as Alum (see *Alumen*).

Dried Alum is best made from the purified and granulated alum described under the preceding title. It is quite unnecessary and very tedious to wait several days for the alum to effloresce at 80° C.

In a capsule, over any convenient source of heat it easily melts in its water of crystallization, and any moderate quantity of it may be stirred down to dryness in about 15 or 20 minutes, and the heating may then be raised and pushed on until the proper weight is attained. As the drying proceeds it is essential that the alum should be constantly stirred. If not, that which is at the bottom of the capsule will in a very few minutes be overheated and spoiled. The process should direct the use of a tared capsule and the very essential stirring.

"Burnt Alum" has been used externally as a corrigent, astringent, absorbent and cleansing application to abraded and discharging or exuding surfaces, since the early times of the healing art. Applied to exuberant granulations its stimulant and astringent effects are well known. Variously diluted with some inactive absorbent powder its application to indolent discharging surfaces is often highly beneficial. To abrasions which become indolent and not disposed to cicatrize the application of such a powder forms a protecting scab, which usually remains firmly adherent until cicatrization is complete, thus forming a most effective dressing. The principle of its action is that it absorbs about its own weight of water without becoming liquid, and from being insoluble and inert when first applied, it becomes stimulant and astringent, cleansing and disinfectant, as it is rendered active by the slow absorption of water from the secretions of the part.

Some twenty years ago the writer made a compound alum powder which when diluted was found to be a very useful dry dressing in a large number of indolent sores. This powder soon found its way into veterinary use, being there used undiluted. Draught animals are very liable to accidental abrasions and slight injuries which easily become chronic sores, but which if protected by a scab of this powder generally heal rapidly.

The Compound Alum Powder consists of camphor, 2 parts dissolved in liquified carbolic acid 4 parts, and the solution intimately mixed with 94 parts of finely powdered Dried Alum.

Various modifications of this powder have been sold in large quantities under various names, as proprietary articles, the ingredients added being generally for the purpose of masking or secreting the composition,—and in the street railroad stables where there are thousands of horses it has done excellent service, and often been supplied at high prices. By this time, however, the original formula is pretty well known, and some of the companies, if not all, now have it made for themselves.

HYDRATE OF ALUMINIUM, or hydrated alumina, is introduced in

this revision, but for what reasons, or for what good purposes the writer does not know. As one of a large number of absorbent, antacid powders it might be useful if the others were not present with their uses better known. Like oxide of zinc it becomes astringent and antiseptic when acidified in the action of correcting acid secretions or excretions, but has no advantages over this and other similar substances, which are less expensive and of far easier access.

SULPHATE OF ALUMINIUM is continued from former revisions without any known reasons why it should be retained. It has no known pharmaceutical uses, and is much more rarely heard of among physicians or seen in their literature than hundreds of other things which are not considered worthy of an officinal recognition. It has now been officinal since 1860,—quite long enough to have developed its special uses, if it had any in the materia medica.

BENZOATE OF AMMONIUM. This is merely a soluble form of benzoic acid, or a means of administering benzoic acid in solution. No medicinal advantages over benzoic acid have ever been claimed for it that the writer knows of. It is, therefore, simply a pharmaceutical convenience, and perhaps hardly that. Benzoic acid is very easily and very promptly saturated by ammonia passing at once into a solution of this salt, and the salt is always given in solution, and the dose is always based upon the proportion of benzoic acid which it contains. Therefore the physician who wants to use it has only to take the proper quantity of the acid, add a little water,—saturate the acid with water of ammonia and then dilute this solution to the measure required for his doses. All the trouble and expense of crystallizing the salt, or of testing its purity if bought, are thus saved, and yet exactly the same result is reached, because the crystals are always used in solution. Another advantage of making this salt extemporaneously, is that the pharmacist or physician will then know what kind of benzoic acid it is made from. It should always be made from the benzoic acid from benzoin, because that made from horse urine is not fit for medicinal use, (see the note upon Benzoic Acid, at page 300), yet manufacturers of this salt are very apt to take the cheapest benzoic acid they can get,—or rather, they are not at all likely to use the proper though comparatively expensive acid from benzoin.

AMMONII BROMIDUM.

BROMIDE OF AMMONIUM.

NH_4Br; 97.8 — *NH_4Br*; 97.8

Colorless, transparent, prismatic crystals, or a white, granular salt, becoming yellow on long exposure to air, odorless, having a pungent, saline taste, and a neutral reaction. Soluble in 1.5 parts of water and in 150 parts of alcohol at

15° C. (59° F.); in 0.7 part of boiling water and in 15 parts of boiling alcohol. Upon ignition the salt volatilizes completely without melting. The aqueous solution, when heated with potassa, evolves ammonia. If disulphide of carbon be poured into the solution, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint.

If diluted sulphuric acid be dropped on the salt, the latter should not at once assume a yellow color (bromate). If 1 Gm. of the salt be dissolved in water, some gelatinized starch added, and then a few drops of chlorine water carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids (iodide). On adding to 1 Gm. of the salt dissolved in 20 C.c. of water, 5 or 6 drops of test solution of chloride of barium, no immediate cloudiness or precipitate should make its appearance (limit of sulphate). If 3 Gm. of the well-dried salt be dissolved in distilled water to 100 C. c., and 10 C. c. of this solution treated with a few drops of test-solution of bichromate of potassium, and then volumetric solution of nitrate of silver be added, not more than 31.4 C.c. of the latter should be consumed, before the red color ceases to disappear on stirring (abs. of more than 3 per cent. of chloride).

1 Gm. of the powdered and dry salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.917 Gm. of dry bromide of silver.

The above description and tests is very full and complete, leaving little to be desired. On one single point they do not agree with the writer's experience in frequently testing the product of the best makers in the market. The reaction of a solution of the salt with litmus paper has always been, not neutral, but decidedly acid.

In applying the solubility test, it is very convenient to put together 6 parts of the salt and 8 parts distilled water, in a large test tube with a thermometer bulb passed through the cork. Then applying the warmth of the hand the salt should be all dissolved, by shaking, when the thermometer has reached 23° C. or 73.4° F. This indicates a slightly greater solubility than is given in the officinal text.

In applying the test given for chloride, the end reaction is not sharp, and yet the test is a good one within practical limits if very closely watched. Of the volumetric solution of nitrate of silver, 30.7 c.c. represents pure bromide of ammonium, and each ·23 c.c. more of the silver solution represents about 1 p.c. of chloride of ammonium, provided there be nothing present to confuse the reaction, and hence 31.4 c.c. of the silver solution represents a mixture of 97 p.c. bromide of ammonium and 3 p.c. chloride of ammonium. But if the chloride present should be potassium or sodium, the indication would be defective, and the ignition test does not check this, since small proportions of these chlorides might be volatilized with the ammonia salt without melting so as to be visible.

Therapeutically bromide of ammonium is a simple alternate for bromide of potassium, and bromide of sodium. The active agency in all three salts is the bromine, and the combination of this ele-

ment in all simply enables it to be administered in large quantities without poisonous effects. The bromine present in even the most moderate dose of any of these salts would be deadly if put into the stomach in a free state, and hence it is important that they should not be decomposed in the stomach with the effect of setting the bromine free. Of the three salts the ammonium salt is the easiest to decompose, and therefore is most liable to be irritant and unsafe. It also contains the largest proportion of bromine, and is therefore less mild than the others. The molecular weights of bromides of ammonium, sodium, and potassium are 97.8, 102.8, and 118.8, and therefore the equivalent doses, or the dose of each which would contain the same amount of bromine, would be for 20 grains of the ammonium salt, 21.02 of the soda salt, and 24.3 of the potassium salt.

Bromide of ammonium is comparatively little used except in association with the other bromides and with hydrobromic acid, and modern experience seems to indicate that it is perhaps not less used than formerly, but that in the increasing use of bromides this does not increase as rapidly as the potassium salt. The taste is much more disagreeable than that of the potassium salt, and becomes more disagreeable by prolonged use, and is more irritant and less acceptable to the stomach. In common with salines in general, it is best given in iced water. The dose is that quantity which will yield the desired degree of bromine effect. In some persons this may be 10 grains three times a day, and in others 50 grains. For its full effect bromism must be induced, and the dose be then diminished so as to fall just short of that. For such use about 20 grains 3 times a day will be about the proper dose to begin with. Its principal use is in the treatment of epilepsy, but it is probable that the potassium salt is better adapted to this purpose.

The writer has treated successfully several cases of confirmed epilepsy by the potassium salt, but has had no personal experience with the ammonia salt, simply from having seen no indication for it in the presence of the other.

The prescription so commonly used in epilepsy, which originated with Brown-Sequard, contains both the ammonium and potassium salts, but it has not been proved to have any advantage over a simple solution of the potassium salt, while for prolonged use it has been said to disturb the stomach more.

In the prolonged use of any of the bromides, there is a considerable advantage in adding a moderate proportion of hydrobromic acid,—say 5 to 10 minims in each dose, and continuing the addition for a month or so at a time, but returning to the simple solution from time to time.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. NOVEMBER, 1884. No. 6.

ABSOLUTE ETHER.

(IMPORTANT CORRECTION.)

The writer is very much indebted to Dr. A. B. Lyons, of Detroit, Michigan, for calling his attention to a gross blunder made in the calculations for specific gravities of Absolute Ether, on page 588, of the July number of these pamphlets. Those who preserve these pamphlets should at once turn to that page and write across the lower half of it the words "incorrect. For the correct figures see page 677."

The blunder made consists in having wrongly divided the difference in specific gravity for 11° C. The difference for 11° C. is ·01240. This divided by 11 gives ·001127+ for each 1° C., instead of ·00127+ as there printed. That is, a unit in the fourth decimal place was in some accidental way dropped out. The erroneous difference for 1° C. having then been used for reducing the specific gravities of the various authorities to a common s.g. of 15° C., they were nearly all given wrong, the error being, of course, multiplied in each case.

In now going over the figures again for this correction, another blunder is found. In giving the s.g. at 15° C. for Allen's first s.g. of ·7185 at 17.5° C., the difference for 2.5° C. was subtracted instead of being added, so that in this case there was a double blunder. The entire half page should read as follows :

The writer's determinations for absolute ether, as given farther on, are ·73128 at 4° C. and ·71888 at 15° C.—difference for 11° C. ·01240 ;—or for 1° C. ·001127+ Adopting then the quantity ·001127 as the coefficient of expansion for 1° C., and by it bringing

all the authorities above quoted to the uniform temperature of 15°C., they stand very nearly as follows:

Dumas and Boullay's,	·713 at 20°	is equivalent to	·71864 at 15°
Saussure & Thénard,	·7155 " 20°	"	·72114 " 15°
Gay-Lussac,	·7119 " 25°	"	·72317 " 15°
Richter	·706 to ·710 " 20°	too indefinite for computation, but mentioned because much lower than any other authority met with, with the possible exception of Boullay, who is quoted by Gmelin ·690, but without any temperature given.		
Kopp, as quoted by Gmelin,	·73658 at 0°	is equivalent to	·71967 at 15°
" " others,	·73568 " 0°	"	·71877 " 15°
Watt and Wurtz,	·723 " 12.5°	"	·72018 " 15°
Mendelejeff,	·73644 " 0°	"	·71953 " 15°
Allen,	·7185 " 17.5°	"	·72132 " 15°
"	·713 " 15°	"	·713 " 15°
Roscoe and Schorlemmer,	·73568 " 0°	"	·71877 " 15°
" "	·70240 " 15°	"	·70240 " 15°
The writer's determination	·73128 " 4°	"	·71888 " 15°

MODERN PROGRESS IN MATERIA MEDICA AND THERAPEUTICS.

Read before The N. Y. State Medical Association,
At the First Annual Meeting, November 18, 1884.

BY E. R. SQUIBB, M. D.

Twenty-five years' experience in supplying a small part of the medical profession with some of the established articles of the materia medica suggests a retrospect of what has appeared to be the progress made in the remedies used and the use of remedies in the treatment of disease.

The very large and important modern progress in the discovery and application of new remedies, and the improved views and processes of the books and journals are not to be considered here, but only the elements of that slow and substantial progress made among that class of close observers, scattered all over the nation, who learn most and improve most on their own observations and experience,—who read much, but rarely write, and are rarely seen in the medical societies, and whose progress, therefore, has to be inferred from the use of the materials they employ in the prac-

tice of their art. The number of those who are quite outside of the medical organizations, or who are simply enrolled without taking any active part, is very large indeed, and their value and influence in the profession is very great, and is generally conservative and good.

From a pretty close association with some of this class in all parts of the country, through their correspondence and a certain familiarity with their wants in the materia medica, when not prompted by the ubiquitous drummer and his wares, the following points of progress are either indicated by facts, or inferred from collateral circumstances; and the points are made here, in the loose form of inference, not simply nor principally as a retrospect of the past, but as being of much more importance in the progress of the future.

That is, modern progress is taken in the sense of learning from the advancement of the near past what to work for and look for in the near future.

First, the thoughtful physician seems more and more to realize the fact that his success, as an individual as well as the success of his profession, depends upon his real utility to the public. As the age grows more and more utilitarian, so the profession has answered and must answer to this progress. The demands of the public upon the medical profession are that disease be prevented as far as practicable; be successfully managed when it comes, and that its damages be skilfully repaired; and in proportion as these demands are rationally and successfully met, will be the standing of the individual and the profession to which he belongs.

This public, though much interested in abstruse researches and ingenious speculations and theories of health and disease, is only entertained or amused by them, and the profession not only gets little substantial credit for them, but often has them turned against it in ridicule. All this is becoming better understood and realized, and the physician is looking more and more carefully, not only for knowledge, but for the means of applying it. He makes the accurate investigation of disease, but does not rest there, but tries to control the abnormal conditions found. Much less is heard of expectancy;—much less of "Young Physic," than formerly. Active agencies carefully studied and skilfully used are much more common now, and the search after such agencies is even becoming hurtfully keen, so that there is danger of the opposite extreme from the former expectancy.

Instances might easily be given of individuals of no uncommon

attainments or opportunities, gifted with neither the polished manners nor liberal morals which so often contribute to one kind of success, but fairly equipped with the known means of controlling disease, who, often in frontier populations, within five or ten years, show to the communities in which they work, the utilitarian value of a doctor, and through him of his profession also. Success to his community means success to him and to his profession at large. And the success which begins in the actual results of his skill and labor in his community endures and increases just in proportion to its utilitarian character. Thermometers, urinometers, litmus paper, test-tubes and a few reagents, are always found in the orders of such physicians, and plain microscopes and even sphygmographs, occasionally. Their materia medica proper is commonly simple, the articles not numerous, but effective, and rarely outside of the Pharmacopœia, and their orders for the newest and best advertised remedies are often conditional, always in very small quantities, and as a general rule, not repeated.

Few will doubt the dependence of the profession for success upon its utility to the public, and very much of this utility must always depend upon therapeutics, and this in turn, upon the materia medica. Hence, if there be a progress in materia medica and therapeutics, it is an improvement of the very foundation upon which the medical profession rests, and its importance in the future can hardly be over-estimated.

Another important reformation that appears to have been slowly and steadily going on in the near past is in the value of the word cure. The old idea of specific or particular diseases and specific cures seems to have undergone considerable modification for the better, not only in the intelligent portion of the people, but also in the medical profession. That diseases are all so many definite entities, for each of which there is a special cure or antidote, if it could only be discovered ; and that incurable diseases are only those for which cures have not yet been discovered, but for which they may be discovered at any time,—is a doctrine which common education in the sciences is steadily bringing into a newer and truer light. Many physicians successfully treat disease,—if not diseases, but very few undertake cures. Neither do intelligent persons call physicians with the unmodified idea of being cured. But they rather seek for skilled advice, and submit themselves with more or less confidence to be so controlled that they may have the best chances of speedy recovery. And when well, they are not so often, in their

own language,—and still more rarely in that of the physician,—cured, but have simply recovered. Modern progress seems to indicate that the farther both the public and the profession get away from the old meaning of this word cure the better, for when it is properly understood in the modern light of cause and effect much complex, indiscriminate drugging will be saved, and the dealers in cures,—from corn cures to cancer cures,—will have their mercantile enterprises better understood. If modern therapeutics is coming to have less and less to do with cures, in the old acceptation of the word, then materia medica is surely equally progressive, for there are probably hardly any now who believe in the possibility that any drug should cure any disease, and therefore it is doubtful now whether there be much chance left, in the profession of medicine at least, for repetitions of the episodes of Cundurango, Missisquoi Water and mud, and Chian Turpentine. But as the doctrine of cures disappears, the utility and certainty of remedial agents become better established, so that the modern progress is attained in both directions.

Another element in the progress of the near past is a gradual and steady emancipation from the trammels of arbitrary doses of medicines. Physicians are no longer satisfied now with the doses given in the books. With increasing knowledge and broader views they now look for effects, and the time is, perhaps, not far off when the only use of stated doses of medicines will be to know what quantity to begin with. It has come to be very commonly recognized that different persons, and even different conditions of the same person, are very differently susceptible to the action of medicines, and that within certain limits, quantities must be adjusted almost to each individual case. In three successive cases of confirmed epilepsy in adults, the number of seizures were not sensibly reduced short of 100 grains of bromide of potassium a day in one case;—160 grains in a second case, and 240 grains in the third case, and these quantities produced only moderate bromism. Had the doses of the standard books been adhered to, two out of the three cases would have been unimproved by the medicine.

There are cases wherein the ringing in the ears will be caused by 2 grains of sulphate of quinine, and there are others which require 60 grains to give this sign of saturation, and there are persons in whom different quantities are required at different times. To treat a recurring malarial fever without recognizing these facts is to fail of success, and discredit both the physician and the medi-

cine, in a considerable number of the most difficult cases, where most credit is to be gained. Dr. Wm. H. Van Buren, more than twenty-five years ago, emphasized this liability to be trammeled by arbitrary doses. In the treatment of consecutive syphilis he found a number of cases recovered under the use of 40 grains of iodide of potassium a day. But others were not impressed by less than 100 grains a day, while a few required 480 grains a day to give similar results. His teaching, and that of others who followed him, applying the same principle to other agents, have done much for the modern progress in this important matter of doses, for it is generally realized now among the best therapeutists that no remedy can be properly considered as having failed until it has been pushed to a physiological or a pathological effect.

There has also been a very important progress made in the knowledge obtained and applied in scrutinizing the quality of medicines, and that has resulted in the production of a better class of medicinal agents than was ever before attained. And it is of no small advantage to have learned that this close scrutiny and discrimination by individuals throughout the length and breadth of the land, is far the most effective way of checking adulteration, and the mismanagement of carelessness, ignorance and cupidity in the vending of medical supplies. Year by year more physicians realize the fact that the drummer is not their safest dependence, drum he never so wisely, and they listen to his voice and take his samples more warily, trusting rather in their own ability to judge of the agents which are so important to them and their patients.

Every year more Pharmacopœias are sold, and more physicians confine themselves mainly within its scope, and more tests and reagents are used; and now that the Pharmacopœia has a full set of officinal test-solutions, it may be confidently expected that still more physicians and pharmacists will learn to apply them in this important interest of effective medicinal agents. All physicians who want to know it, know now that it is not the writing of papers on adulterations, nor the resolutions of societies so much as the individual knowledge, care and watchfulness of each physician for himself, that secures to him the character of his supplies. It has always been the case that good supplies could be easily obtained by proper care and scrutiny, but it has never been so easy as it is now, in consequence of the general improvement in the quality of supplies, and the wider market for selection.

Moderately good and poor qualities are as plentiful and as cheap

as ever, but the physician having learned that cheap supplies is poor economy, is upon his guard if he desires to be. He has also learned that high priced supplies are not always the best, and hence his safety only in his own testing processes, and in avoiding complex remedies, and forms of medicine which it is difficult or impossible to test.

Another element of progress notable within the past few years is that physicians use fewer and more active agents and use them more simply. The time for complex prescriptions, and of using several agents at the same time, seems to be passing away, and physicians do not go from one preparation to another so easily as heretofore. The using of a few definite agents and knowing from personal observation just what they will do, is of such manifest advantage that it would be strange indeed if there was no progress here. Physicians' orders, from being long, and embracing many doubtful and indefinite articles, and many duplicates, or articles used for similar purposes, are now short and compact in the main. Ten to fifteen standard medicines at a time is about all an ordinary physician wants, and this, about twice or thrice a year, keeps up a supply of not over double that number of agents in all, for common daily use. This enables him to watch the qualities better, and keep his stock fresh and in the most efficient condition.

Much progress has also been made in using more concentrated forms of medicines. Decoctions, Infusions, Vinegars, and Wines have almost gone out of use, while Tinctures and Syrups are steadily falling into disuse, though not as rapidly as they deserve. These are all replaced by the far more accurate and convenient Fluid Extracts with their small and effective doses, which can be so easily administered in so many different ways. Thus the physician and pharmacist, instead of having to keep two or three preparations of the same drug to get stale on his shelves, has to keep only one, and this the best and most accurate one.

Much has also been gained in the precision with which medicines are measured for administration, and the measuring apparatus has been much extended and much improved in accuracy, so that it is not difficult now to get fairly accurate weights and measures at a reasonable cost.

The many and great advantages in the use of the salts of a few alkaloids have led to the extreme of seeking to extract and use the active principles of drugs, instead of the preparations of the drug, in all possible cases, and there are many excellent reasons for this if it

were only practicable. Unfortunately, the so-called active principles rarely represent the drug from which they are taken either fully or fairly, and are of such variable strength that they are less trustworthy than the drug. Beside this, many of the alkaloids and nearly all the glucosides are so loose in their molecular structure, that they split up and become partially or wholly inert without change in appearance, and under circumstances that are not known. Physicians who examine most closely into the character and processes of extraction of many, if not most of these so-called active principles, will see that they are frequently the result of the chemistry applied for their extraction, and that they do not pre-exist in the drug, and therefore can only partially represent it.

Finally, perhaps the greatest progress of all has been in the power and definiteness of the agents used, and in judging of the manner and effect of using them. Many years ago, when among the first of these very definite and powerful agents, the American Helebore, came into use for controlling the action of the heart, it was objected that its use was merely controlling a symptom of disease without going to the root of the matter at all. The pneumonia went on all the same, and perhaps the depressing action of the drug was simply added to the depressing action of the inflammation, and harm rather than good might rationally result. It took some time to show by actual experience that the drug could be given in controlling quantities without more depression than was needed in a sthenic disease, and that the lowering of the pulse rate by fifteen to twenty per cent. meant the sending of fifteen to twenty per cent. less of inflammatory blood through an inflamed, congested and oppressed organ, whose obstructed functions were threatening life, and therefore that treating this pulse symptom was really treating the whole of the disease by controlling its prominent element. It was thus clearly recognizable that by subtracting one prominent element or symptom from the group which constitute a disease, the bond is broken, and it then tends to disintegration, just as when an atom or a group of atoms is subtracted from a molecule, it splits up and loses its identity and its reactions.

Then when bromide of potassium was successful in controlling the seizures of epilepsy it was objected that it merely controlled the expression of the diseased condition, without affecting that condition, since when the medicine was omitted, or was used in too small quantity, the seizures would recur. But in the progress made in the near past it has been abundantly shown that when the

bromide is skilfully managed and continued through a long time, with great perseverance and care, for a sufficient length of time after the attacks have ceased, many patients are no longer in the condition which caused the attacks, and that thus in treating the principal symptom the condition causing it has also been treated successfully.

Again, in those agents which simply reduce temperature,—take, for example, the use of salicylates in acute rheumatism,—the effect is to control one symptom primarily, but it happens that through the close relationsip of symptoms, two others of equal importance are also controlled, namely, the pain and swelling. It is maintained that the disease goes on and commonly runs its course; but it is admitted that it is occasionally cut short, and that it is almost always rendered comparatively free from high fever, pain and swelling,—that heart damage is less frequent and less serious, and that relapses occur less frequently.

It is needless to multiply examples to show that great progress has been made in the acquisition of definite agents and in the knowledge of how to use them, and should the next ten or twenty years prove as fertile in the resources of the medical art as is indicated by the progress of the past, the profession will occupy a much higher position in the estimation of the public than it now does.

It should not be inferred from the above that all the prominent changes in relation to the materia medica within the past few years have been improvements, or for the good of either the profession or the public, for much doubtful medication has grown into common use among large numbers of physicians who do not seem to stop to think where the mercantile enterprise of the manufacturer is carrying them.

COCAINE.

THE NEW LOCAL ANÆSTHETIC.

On the morning of Tuesday, October 7th, the writer received a letter from Dr. Henry D. Noyes, of New York, dated Kreuznach, Germany, September 19th, saying that a medical student of Vienna named Koller had discovered that a solution of hydrochlorate, or muriate, of cocaine of the strength of 2 p.c., when dropped into the eye in quantities, first of 2 drops, and then of 3 drops, with ten minutes' interval, gave, after ten minutes more, an anæsthetic condition of the

cornea and conjunctiva, which continued from ten to twenty minutes, and then passed off gradually. Dr. Noyes had himself witnessed the experiment at Heidelberg, and been very much impressed with its importance, and asked that Dr. A. Mathewson, of Brooklyn, and Dr. Charles Stedman Bull, of New York, be at once told of it that they might investigate the matter.

The writer had in his possession some hydrochlorate of cocaine made by Merck, of Darmstadt, and within six hours after the receipt of Dr. Noyes' letter, sent a vial of the 2 p.c. solution to each of the gentlemen named by Dr. Noyes, and sent the letter of Dr. Noyes to Dr. Mathewson, with the request that he should send it at once to Dr. Bull. But fearing some delay in this, a note was sent to Dr. Bull with his vial of solution, telling him how to use it. Dr. Mathewson happened to be out of town, and therefore his vial and Dr. Noyes' letter remained waiting for his return. In the meantime Dr. Bull, on the afternoon of the 8th, applied the solution, probably for the first time in this country, and wrote that evening that while the anæsthesia was by no means complete, the parts were certainly benumbed, and the pain less than usual in two operations upon the cornea. It was suggested to Dr. Bull that his incomplete results might be due to insufficient quantity, and that as no more than two or three drops could be put into the eye without overflowing and waste, a 4 p.c. solution was made and sent to him for use in the same way, thus doubling the dose. Under date of the 13th he writes that he has continued to use the 2 p.c. solution, and produced by it a certain degree of non-sensitiveness, but not absolute anæsthesia, and therefore he accepts the proffered 4 p.c. solution. This was at once sent, and on the 16th he wrote that it was much more satisfactory, and produced complete anæsthesia in sixteen minutes after the first instillation. From this and other testimony the writer was convinced of the great importance of the agent, and that it was destined, as Dr. Noyes had remarked, to make a great noise in the world. Meanwhile a letter from Dr. Noyes to the *Medical Record* of the same date as that to this writer was published in that journal in the issue of October 11th, and this letter seems to have at once aroused professional attention to an extent not often witnessed. Communications from Drs. C. R. Agnew, W. O. Moore, J. L. Minor, H. Knapp, D. C. Cocks, J. H. Claiborne, Jr., and others followed each other in rapid succession, until, judging by the letters received by this writer on the subject, the whole country was aroused. Even the newspapers reached it, and made a sensation

upon it with the customary exaggerations and blunders, among the chief of which was that cacao or cocoa was given as the source of the anæsthetic instead of coca. The natural effect of all this was soon realized in the supply being promptly exhausted.

Cocaine and its salts have always been very expensive and rather rare in the market,—have always come from abroad, and, so far as the writer knows, Merck, of Darmstadt, has been the principal maker. A very few houses in this neighborhood had each a small quantity of, probably, not exceeding a few grammes, and this small supply was rapidly exhausted. Some buyers were shrewd enough and quick enough to get a few grammes and hold them for the advanced prices which they foresaw, and such have now, for some time past, been the only sources whence any could be had. Orders to Merck, and perhaps to other makers, were cabled out as soon as the excitement commenced, but up to this time, November 19, only two or three small parcels are known to have been received, and it therefore seems quite probable that the demand abroad has also been greater than the present means of supply. The hydrochlorate of cocaine, which is the salt so much in demand, is put up by Merck in vials of one gramme each, and these before the excitement were sold at wholesale at $2.50 each, or about 16 cents a grain ; but the price did not remain long at this figure, but rapidly advanced to about $8.00 per gramme, or over 50 cents per grain before the main supply was exhausted,—and the latest prices heard of were 75 cents per grain, or $1.25 per fluidrachm for a 4 p.c. solution. The orders sent out have been numerous, and for quantities likely to be overwhelming for an article hitherto so little used. A single New York house ordered 2,000 grammes, and had one customer ready to take the whole. Many of these orders are overdue but not heard from, except the two or three small lots above mentioned, and these have come in at increased prices, with notice of still farther advances. Two large houses in this country are advertising a 4 p.c. solution of their own make, and are said to be selling the solution,—the one at $7.00 per ounce, the other at $6.00. The salt of Merck's make, which was sold here at $2.50 per gramme, probably cost the importers about $2, including the 40 p.c. duty, so that Merck's prices must be somewhere about $1.40 per gramme.

It is exceedingly rare that a novelty in the materia medica is so easily and so quickly tried, and still more rare that one is found that is so very definite and so very important in its results, and the future utility of which is so quickly and so easily established, and

hence the importance of a prompt supply of the substance if possible. The great probability that only small quantities of so rare and costly an alkaloid would be either on hand, or in process of making in Europe, and that the demand there would exhaust that, and keep it exhausted for some time to come, leaving but little available for this country, while the demand would be much greater here than there,—induced the writer to try to bridge over the difficulty temporarily, by trying to learn how to make it in small quantities for farther investigation of its uses. It was fully recognized that, like many other similar articles, it cannot be made permanently in this country because of the enormous tax on alcohol and ether here, these appearing to be the chief solvents used in making it, unless some cheaper solvents can be found for its extraction and purification. Another difficulty to be met was that of getting good coca leaves to make it from. In assaying coca leaves the best results the writer has ever obtained were about ·26 p.c. of cocaine, and this is in accordance with other published assays, while upon a manufacturing scale the best results published seem to have been about ·2 p.c. of the hydrochlorate, or 2 grammes per kilogramme, and this for the best leaves. Now as good coca leaves are rarely to be had here or elsewhere, in quantity, at less than $1.00 per pound, and often $1.25, and as a pound yields at most not over 14 grains of the salt of the alkaloid to those who have learned how to make it, it follows that the salt when still in the leaves is worth (1.00÷14=) 7c. per grain or $1.09 per gramme. As the learning how to get it out is costly, and the solvents, apparatus, labor, etc., also costly, there cannot be a large profit on it even in Germany at $1.40 per gramme, and it is therefore much better for the users of it in this country to buy it abroad where it can be made so much cheaper. Nevertheless it seems just now worth while to try to temporarily supply a small quantity, and as the solution would be much more easily made than the solid salt, to aim only at that, and at a strength of 4 p.c. Two lots, only, of fair coca were found in the market at $1.00 and $1.25 per pound, and only one of these at $1.00 was in sufficient quantity. The leaves were green and fresh-looking with fair odor and taste, but appeared to have been gathered and dried when small and young. They were well put up in compact bales of about 100 pounds each, and looked not only much better but much fresher than any seen in the market for two years past. A preliminary qualitative testing showed the presence of cocaine in them, and they were ground to a fine powder, losing about 4 p.c. in

drying and powdering, bringing the net cost up to $1.14 or more per pound.

Upon this powder all the published processes accessible to the writer were one after the other tried, and also some original processes, and some combinations of those of the books, occupying about a month in time and over 100 pounds of powder, with almost negative results. Some processes yielded no alkaloid at all, others only traces, while others gave a few grains which had to be used up in the testings to ascertain their identity. By this time it was suspected that the powder could hardly contain much alkaloid, although in appearance it had been of fair quality,—good enough to warrant its use in the hurry for alkaloid, without taking the time for a quantitative assay. Such an assay, which should have been made at the beginning, was then made at the end of such a loss of time and material, and showed, by the assay process given at page 604 of these pamphlets, that the powder contained about ·18 p.c., or less than two-thirds of what it should contain, and this assay showed that the process given is not well adapted to poor quality of coca, so that a better assay process had to be sought. Four other samples of coca were obtained from the market, costing 65 c., 55 c., 50 c. and 40 c. per pound. On the analogy of tea and coffee it was supposed that the lower grades might possibly yield nearly as much alkaloid as the higher, but this did not hold good here, as some of these lower grades appeared to contain no alkaloid at all, while others contained too little to work with any advantage by so expensive a process or processes. So it became necessary to adhere to the young, green coca as the best that could be had.

Of all the processes thus far tried, none have been at all satisfactory, and others are still being sought out, but that of W. Lossen, of 1862, as given in Gmelin's Handbook, English edition, Vol. XVI., p. 300, seemed to be the best thus far, when modified in some of the details. Up to this time, however (November 19th), nothing like the proper amount has been obtained from the coca, and the small return for so much expense and labor is so discouraging that if a reasonable supply from abroad could be reasonably expected within a short time, it would be abandoned.

As it is, however, the writer still hopes to produce it when better coca can be obtained, and thinks there may possibly be cheaper solvents found for it than alcohol, ether or chloroform. Where such large quantities of a substance have to be exhausted for so small a result as 8 to 12 grains to the pound, and the alkaloid so

sensitive and so easily decomposed, there is no wonder that it requires great skill to prevent its being lost in the large amount of extractive matter. Something like an alkaloid is always obtained by all the processes, but it often proves to contain very little or no cocaine.

Merck's hydrochlorate of cocaine came in the form of a damp, amorphous, granular powder of a rather dusky white color,—several shades off from being colorless. It has a peculiar ethereal odor, and a mildly bitter taste, the taste being very promptly succeeded by a benumbing sensation. It is soluble in strong alcohol, but not appreciably soluble in strong ether. A gramme of the salt gives 387.5 grains, or a little more than seven fluidrachms of 4 p.c. solution. This solution is opalescent or turbid, and requires filtering, leaving several millegrammes of insoluble matter on the filter, and the filtrate is not colorless, but of a greenish-yellow tint, and neutral or slightly alkaline reaction. Of this solution 10 c.c. equal to ·4 gramme of the salt precipitated with solution of carbonate of sodium 1 in 5, gave a white precipitate of the alkaloid cocaine, which, dried at a low temperature, weighed almost exactly ·3 gramme, or three-fourths the weight of the salt taken. It should yield, according to Gmelin, Vol. XVI., p. 302, 88.78 p.c. The precipitated alkaloid is very sensitive to heat, turning brown when dried on a porcelain surface hardly above 70° C. Authorities state that when precipitated by carbonate of sodium it is not soluble in an excess of the precipitant. This may be true, but yet a considerable proportion of the alkaloid can be washed out, by ether, from the mother-liquor from which the alkaloid has been precipitated by a slight excess of carbonate of sodium. If the carbonate of sodium does not dissolve it, the chloride of sodium, which results from the decomposition of the hydrochlorate of cocaine, does. In the precipitation with carbonate of sodium no carbonic acid is given off. The alkaloid when pure or nearly so is but slightly soluble in water, but it is quite soluble in water which holds even small proportions of the extractive matters and the salts of the coca leaves. It is easily washed out of alkaline watery solutions, provided there be but little extractive matter or alkali present,—either by chloroform or ether; but with the substances just mentioned present in any considerable proportion, an emulsion is formed with both solvents that no device yet tried has been able to separate, although much time and pains have been given to the matter.

The solution of Merck's hydrochlorate in distilled water, and the

solution filtered, remains entirely clear for two or three weeks, but some that is now a month old shows the usual signs of microscopic growths. But a solution made at the same time, wherein half the water was replaced by a cold saturated solution of salicylic acid, remains entirely clear and bright, and, judging by analogy and experience with the salts of other alkaloids, it will remain clear indefinitely. The solution so protected has been frequently used without discoverable irritation, and from these circumstances it follows that all solutions of salts of cocaine should be so protected from change.

From what has been said it appears that a 4 p.c. solution of Merck's hydrochlorate contains only about 3 p.c. of the alkaloid, or 3.41 p.c. of the hydrochlorate of the alkaloid, and yet this solution appears to be quite strong enough for all ordinary uses to which it has been applied up to the present time. Many ophthalmologists appear to have succeeded well with a 2 p.c. solution, but they do not mention the quantities of this solution used, and it is inferred from the before mentioned experience of Dr. C. S. Bull that the quantities used must have been larger than he used, and if by this there was any loss of solution by overflow, or much loss of time in waiting for the anæsthesia, and especially if the anæsthesia was not complete, then there is no economy in the smaller cost of a 2 p.c. solution. From all the experience up to the present time it seems probable that a 4 p.c. solution is the best, and the only one needed, as it appears to be strong enough to produce complete anæsthesia with quantities so small as not to involve waste by overflow, or unnecessary loss of time. Abundant experience has shown that in all ordinary cases of eye operations the instillation of two drops into the eye, and, after waiting ten minutes, three drops more, will in ten minutes after the second instillation, give an anæsthesia which will continue complete for about ten minutes, and pass off in about twenty minutes, leaving no irritation or other bad effects. Doubtless weaker solutions will be required for therapeutic purposes, but these can be easily made extemporaneously from the stronger one. Use has been made of both a 2 p.c. and a 1 p.c. solution in painful conditions of the eye with entire relief, but the applications have to be frequently renewed, as the effects pass away rather rapidly. Such solutions are of course very easily made from a 4 p.c. solution as needed, without any necessity for keeping more than the one stock solution.

The effects of cocaine as a local anæsthetic are wonderful, and it

is perhaps still more wonderful that these effects should not have been before discovered. There have been several independent investigations of its physiological and therapeutic effects. It has often been dropped in the eye, and its mydriatic effect was well known. It had also been used for spraying the fauces in laryngology to lessen the sensitiveness to the use of instruments, and its discoverer, Nieman, and many since have noticed its benumbing effects upon the tongue, but it remained for Koller to discover its effects as a local anæsthetic, and thus within a week's time to raise it from an obscure position in the list of useless alkaloids to an importance and utility hardly exceeded in the materia medica. It had been repeatedly given both internally and hypodermically, and found to require large doses, often repeated, to produce any appreciable effect. One grain of it will give complete anæsthesia of an eye for ten or fifteen minutes, fifty times, and yet the same quantity taken into the stomach has hardly given an appreciable effect, and this quantity represents about 400 grains of good coca. Thus there seems to be very little relation discoverable at present between its general effect on the economy and its local effect. As an agent correctly and properly classed with tea, coffee, guarana, etc., as a nervous stimulant it was so indefinite in effect,—at least when of poor quality,—as to lead some close observers to doubt or deny its stimulant action, when now it suddenly comes into view in the opposite role of the most powerful nervous sedative ever known short of absolute destruction of tissue. The action of heat or of chemical cauteries which destroy the tissues, do not more completely obliterate sensation than this agent, and yet it does not appear to interfere with vitality at all, does not irritate at all either primarily or secondarily, and its profound action appears to be followed by no hurtful reaction. With such a character so suddenly acquired, it seems practically to have sprung into existence fully armed for a great amount of future good in the art of medicine. Already it has been applied to many purposes beside those of ophthalmology, and extravagant and improbable statements in regard to its effects are circulated, and it has also, doubtless, been often misapplied, but it is far too well tried to be classed with the doubtful novelties of the time, or have an uncertain importance in the future. The difficulty now is to get it for application.

One of the most interesting points in connection with it is, as to what becomes of it in action. Unlike atropine and other alkaloids its effects are very transient. Is it as easily and as rapidly decom-

posed into inert substances in action as it appears to be in the process of extraction from the leaves? Or is it simply diluted as it is absorbed into the circulating fluids, and simply ceases to act from dilution.

Another curious point is its differing activity upon different persons. A piece of paper a quarter of an inch square, wetted with a 4 p.c. solution and laid upon the tongue will give a pretty distinct sensation of the size and even the form of the insensitive or numb spot within one minute on some persons, while in others it will take twice and three times that length of time, and give a more faint impression, while in one case met with it gave no impression at all. Bibulous paper wetted with the solution and dried may be carried in the pocket, certainly for some days, and probably for an indefinite period, and when cut and laid upon the moist tongue will promptly produce the characteristic effect.

The agent, for reasons given above, must always be an expensive one unless it should be made synthetically, as is not improbable, —but the expense, for many uses at least, is not so great as appears at first sight. Take its use in eye surgery as a good example. For any ordinary eye operation two fluidounces of ether or more are required for an anæsthesia, costing not less than ten cents at the least. Five minims of the four p.c. solution of the cocaine salt gives the required local anæsthesia at a cost, after the present excitement passes, of not over five or six cents, while the time and skill required in the two applications are pretty nearly equalized. But in the one case the whole organism has to be anæsthetized for an operation of a few minutes upon a single small part, while in the other case only the part itself is rendered anæsthetic. Should the demand for salts of cocaine remain greater than the supply, and very few people be able to get good coca, or learn how to make the salts, as is not improbable for some months at least, holding the price still up to, say, $1.00 per fluidrachm for the 4 p.c. solution, this would give about 1.67 cents per minim, or 8.33 cents for a single anæsthesia for the eye, and a proportionate cost for other uses.

The opportunities for an extensive use of the agent are very numerous and important. Its principal effects so far have been for the most part upon mucous membranes, or upon surfaces denuded of cuticle, and it is not known how far it will affect unbroken skin or the tissues beneath. Some superficial neuralgias are said to have been benefited by the application of the solution, and upon this the writer has suggested the use of the paper wetted with the solu-

tion and then dried,—the paper to be cut of the size of the superficial pain,—to be wetted and applied to the part, and then to be covered with oiled silk a little a larger than the paper. The results of such applications have not yet been heard from.

A far better preparation for such uses would be, however, an oleate of cocaine. The alkaloid unites directly with oleic acid and forms a true salt, and this salt is a principal object the writer has in view if he should finally succeed in making the alkaloid. The facility with which these oleates are absorbed by sound skin, and the depth to which they probably penetrate before being too much diluted by the circulating fluids, give, theoretically, great promise for the use of such a preparation for the relief of local pain.

In short there can hardly be imagined a larger field of usefulness than is now open for investigation by means of this new agent, and although there will be many disappointments and very much overzealous enthusiasm, it is fortunate that but little harm can be done with it beyond the waste of so scarce and valuable a substance, as there has been no case yet reported in which any poisonous or bad effects have resulted from its use even when internally administered in grain doses.

The close relationship, if not identity, in physiological effects and popular usage of coca with tea and coffee, as a nervous stimulant, has led to the rational inference that caffeine might also prove to be a sedative or anæsthetic like cocaine, and some trials of caffeine have been published as unsatisfactorily. But all the trials published, as well as those heard of from private sources, have not been so conducted as to be conclusive. When compared as they exist in coca and in tea, cocaine is about eight times stronger than caffeine, and therefore it might be expected that a 32 p.c. solution of caffeine would be required to do what a 4 p.c. solution of cocaine would do, and such a solution is at present impracticable. Beside, it is reported that solutions of caffeine are irritant to the eye.

As this paper is going through the printer's hands (November 19) both Messrs. McKesson and Robbins, of New York, and Messrs. Parke, Davis & Co., of Detroit, announce that they are supplying a 4 p.c. solution of hydrochlorate of cocoaine to any who want it. The many correspondents of this writer who want the preparation will therefore save themselves the trouble of writing for it unsuccessfully by supplying themselves from these sources rather than wait longer for the writer's slow movements in the matter.

THE PHARMACOPŒIA OF 1880.

(Review Continued.)

AMMONII CARBONAS.

CARBONATE OF AMMONIUM.

$NH_4HCO_3.NH_4NH_2CO_2$;157.— $NH_4O,HO,2CO_2.2NH_3CO_2$; 157.

Carbonate of Ammonium should be preserved in well-stopped bottles in a cool place.

White, translucent masses, consisting of Bicarbonate (Acid Carbonate) of Ammonium and Carbamate of Ammonium, losing both ammonia and carbonic acid gas on exposure to air, becoming opaque and finally converted into friable, porous lumps, or a white powder (Acid Carbonate of Ammonium). The salt has a pungent, ammoniacal odor, free from empyreuma, a sharp, saline taste, and an alkaline reaction. Soluble in 4 parts of water at 15° C. (59° F.), and in 1.5 parts at 65° C. (149° F.). Alcohol dissolves the Carbamate and leaves the Acid Carbonate of Ammonium. When heated, the salt is wholly dissipated, without charring. If the aqueous solution is heated to near 47° C. (116.6° F.), it begins to lose carbonic acid gas, and at 88° C. (190.4° F.) it begins to give off vapor of ammonia. Dilute acids wholly dissolve the salt with effervescence.

On acidulating the aqueous solution with nitric acid, no turbidity should be produced by test-solutions of chloride of barium (sulphate), or of nitrate of silver (chloride), nor by hydrosulphuric acid (metals). If 1 Gm. of the salt be supersaturated with diluted sulphuric acid, then diluted to 20 C.c. with distilled water, and treated with a few drops of test-solution of permanganate of potassium, the color should not be perceptibly changed by standing for five minutes at the ordinary temperature (abs. of empyreumatic substances).

To neutralize 2.616 Gm. of Carbonate of Ammonium should require 50 C.c. of the volumetric solution of oxalic acid.

Preparation : Spiritus Ammoniæ Aromaticus.

The officinal Carbonate of Ammonia is a selected portion of the commercial article, and is never made specially for medicinal uses ; and even when selected with the greatest care, at a considerable advance in price over the ordinary commercial article, it is of a somewhat variable composition, and rarely agrees accurately with the above given formula. Not many years ago this country was supplied almost exclusively from Great Britain, and it was often difficult to get it good enough for medicinal purposes. A variety or quality which was called "Volcanic" was, however, generally of very good quality and very free from empyreuma, and commanded a high price. Within the past few years, however, it has been largely made in this country and of excellent quality, and the

enterprising firm which undertook it has so far been able to withstand the terrible competition from abroad. It is now almost always made from the sulphate of ammonia, and the source of the ammonia in the sulphate seems to be the most important element in the manufacture of a good article. The German sulphate, made from urine, even when roasted, still gives an empyreumatic product. But the ammonia from gas liquor when well managed, and the sulphate well roasted, gives the unexceptionable product of the American manufacturers.

When of proper quality for medicinal uses it should always be in colorless, translucent pieces of striated fracture with cross strata marks or joints, and should have but a very light covering of the white, dust-like bicarbonate on the surfaces. The empyreumatic odor is very rarely strong enough to be detected by the smell, as even when present to an objectionable extent it is masked by the pungency of the ammonia. When the ammonia is saturated, however, it is easily detected, and there is scarcely a better test for this salt than the making of the Liquor Ammonii Acetatis from it, for this Spirit of Mendererus is unfit for use when it has any empyreumatic odor.

The stated solubility in 4 parts of water at 15° C.=59° F. is practically correct, but it is not soluble in 1.5 parts of water at 65° C.=149° F. as stated, for the reason that the salt is decomposed far below that temperature; and this reason is given a few lines farther on in the paragraph when it is stated that the aqueous solution when heated to near 47° C.=116.6° F. begins to lose carbonic acid gas. The statements are not only incompatible, but unless specially qualified both are erroneous. They appear to have been made on the authority of Dr. Edward Divers who, in 1870, published a most careful and exhaustive paper "On the Combinations of Carbonic Anhydride with Ammonia and Water." This paper is found in "The Journal of the Chemical Society of London," for 1870, Vol. 23, p, 171. Dr. Divers says, at page 242, that the strongest hot solution that he had been able to make was 1 to 1.5 water, but he does not say that this was without decomposition of the salt, or that it was at 65° C., but only says that but little carbonic anhydride was lost, and that from other experiments he believed the temperature to be about 65° C. The writer repeated Dr. Divers' experiment with an excellent specimen of the salt under accurate conditions, and had the stopper blown violently out of the bottle by the escape of gas, and this as often as it was replaced un-

til the decomposition was complete. Another repetition of the trial at a lower temperature showed, that with this proportion of water, and the bottle in a carefully adjusted bath, the decomposition commenced at 42.3° C. and increased rapidly as the temperature was increased. When a solution of 1 part in 4 of water was heated in a bath the evolution of carbonic acid began at about 47° C. as stated by Dr. Divers, while with more dilute solutions the decomposition began at a higher temperature still. The Pharmacopœia should, therefore, drop the statement of solubility at the higher temperature, and should qualify the statement of commencing decomposition at 47° C. by stating that it is the 1 to 4 solution which begins to decompose at that temperature.

It is perhaps necessary to state this writer's method of taking the solubility of salts, as it is both a simple and effective one. A large long test-tube, such as Messrs. Whitall, Tatum & Co.'s graduated 30 c.c. test-tube, is fitted with a good stopper,—rubber by preference,—and through this stopper is passed a thin chemical thermometer whose error is known throughout its range. The weighed quantity of the salt in powder and the solvent are put into the tube, the thermometer bulb pushed down to near the bottom, and the tube is then put into a water-bath whose temperature is regulated by another corresponding thermometer. The temperatures being now adjusted and kept well regulated, the tube is taken out and shaken from time to time. Should the salt fail to dissolve at the prescribed temperature, the temperature of the bath is very slowly increased until the salt is very nearly but not quite all dissolved by the shaking. The temperatures are then held steady while the shaking is continued until all, excepting a few small particles, is dissolved. The temperature of the bath is then slowly reduced until the first signs of crystallization are observed, the few particles left undissolved being sufficient to start the crystallization at the critical point. The inside thermometer now indicates practically about the point of saturation for that temperature, and therefore very nearly the solubility, and this point is usefully checked by the point at which the last portions were dissolved in slowly raising the temperature. If the observation be trustworthy these two points will, of course, not be far apart, and in moderately careful, close work, they are so near together that the mean should be taken rather than the crystallizing point, for when crystallization is rapid the temperature rises sensibly.

The tests given for sulphates, chlorides and metals are simple

and full, and the test for empyreumatic substances by solution of permanganate of potassium is an excellent one. The quantity of test-solution added should, however, be as definite as the quantity of the salt to which it is added, because the change of color can only be well seen when the liquid is of a faint pink tint. The testing should be done in a glass-stoppered tube or vial, and not more than five drops of the test-solution should be added, and the vial should be set upon white paper. The best salt now in the market will stand this important test for half an hour easily.

The final test by neutralization is important, but rather difficult of application, and rarely gives the same indication, because of the slight differences in different lots of the salt. The best way to apply the test is to put the weighed portion of the salt in a large deep beaker covered with a watch-glass, and slowly run upon it, through the smallest practicable uncovered opening, say 50 c.c., or a measured excess of the volumetric solution of oxalic acid. When the effervescence has ceased the watch-glass is rinsed into the beaker, and the solution is boiled to expel carbonic acid. When cool it is titrated back with volumetric solution of soda. The slightest excess of soda then gives an ammoniacal odor to the solution. An excellent specimen of the salt carefully treated in this way required between 39 and 40 c.c. of the oxalic acid for neutralization, instead of 50 c.c., as prescribed by the Pharmacopœia.

In giving the "Preparations" in which this salt is used the Pharmacopœia omits the Liquor Amonii Acetatis.

Carbonate of Ammonia is a very prompt and effective diffusible stimulant of short duration, but leaving no after depression. In well regulated quantity, frequently repeated, a continuous supporting or sustaining effect of any desired degree may be attained and maintained through any crisis of depressing disease where such effect becomes desirable, and often very important. No ammoniacal salts can be well adapted to very prolonged use, because after a time they impoverish the circulating fluids, and hence the importance of the skill to know when, how, and how long to use them. Certain conditions of general depression of the vital forces occasionally occur in many diseases, and such conditions are often called typhoid, and are often fatal in their tendency. It is to such conditions that carbonate of ammonia when skilfully applied is often applicable, and with or without alcohol, is the means of saving life.

It should always be given in solution, and the dose should be well diluted at the time of taking. The quantity needed must be deter-

mined for each case and condition, and requires close observation to adjust it aright. Commencing with about 3 to 5 grains every one or two hours, the needed stimulation is closely looked for in temperature, pulse, etc., and the quantity increased until the effect is obtained, or some adjunct, like alcohol, is seen to be necessary. It is not an aliment in such cases, as alcohol is, but it has the advantage over alcohol that it is not excitant, and is less liable to awaken irritability, and delirium is less frequently increased by it.

In the use of most medicines there is a narrow line of greatest benefit, that being reached only by close observation, marks the skill of the successful physician, but there are probably few medicines where this line is so narrow, yet so easily reached by care and skill, as with carbonate of ammonia, when it is needed to give a few days of support in conditions which, without it, would be desperate. But just when to begin with it, what quantities to use, and when to omit it, are matters of quite as much importance as the agent itself.

AMMONII CHLORIDUM.

CHLORIDE OF AMMONIUM.

NH_4Cl; 53.4. — *NH_4Cl;* 53.4.

A snow-white, crystalline powder, permanent in the air, odorless, having a cooling, saline taste and a slightly acid reaction. Soluble in 3 parts of water at 15° C. (59° F.), and in 1.37 parts of boiling water; very sparingly soluble in alcohol. On ignition, the salt volatilizes, without charring, and without leaving a residue. The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. Test-solution of nitrate of silver added to the aqueous solution previously acidulated with nitric acid, produces a white precipitate soluble in ammonia.

The aqueous solution of the salt should remain unaffected by diluted sulphuric acid (abs. of barium), hydrosulphuric acid or sulphide of ammonium (metals), and after being acidulated with hydrochloric acid, it should not be rendered turbid by test-solution of nitrate of barium (sulphate). A one per cent. aqueous solution should not be rendered blue by test-solution of ferrocyanide of potassium (iron).

Preparation: Trochisci Ammonii Chloridi.

The salt here described for medicinal use is made from the sublimed sal ammoniac found in the market in large striated masses, often much stained with iron. A cold saturated solution of the commercial salt is slightly supersaturated with water of ammonia, and after being allowed to stand over night is filtered through paper. The filtered solution is then boiled down until reduced to about

half the original volume, when it is allowed to cool. As soon as crystals begin to form the liquid is actively stirred, and this stirring is frequently repeated during the crystallization so as to form small granular crystals which may be easily washed clean. The crystals are then drained and percolated with distilled water until all the mother liquor is displaced and the crystals well washed. They are then spread out and dried at ordinary temperatures. The result is a granulated chloride of ammonium nearly chemically pure. The crystals are of fairly uniform size, with angles rounded by the washing, and although small, they are rather large to be called a crystalline powder. It is perhaps this salt powdered, or powdered chloride of ammonium, to which the officinal description is intended to apply. It is a difficult salt to powder from its toughness, and the best that can be done with it is to make a crystalline powder which invariably cakes, or gets into lumps, in the bottles or tins into which the powder may be put. These lumps, however, are easily broken down into a peculiar dead or clammy powder.

When 6 grammes of the salt and 18 c.c. of distilled water are shaken together in a tube mounted with a thermometer, the temperature falls at once to about 9° C., and if the shaking be continued the salt is all dissolved by the time the temperature has risen to 12° C. Its solubility is therefore greater than is indicated by the Pharmacopœia. With this exception the description and tests are accurate and full. The final, separate test for iron is perhaps unnecessary in the presence of the other tests for metals.

Chloride of ammonium or muriate of ammonia is very largely used in medicine, and its use has increased so largely and so steadily during the past ten years, without any special fashion or advertising, that there can be no doubt of its utility, or of the definiteness of its effects in general practice. Yet it is one of those medicines which writers find it difficult to classify by its effects. Its most general useful effect is to attenuate or liquefy tenacious secretions or deposits which obstruct surfaces, plug up minute cells and ducts, and thus obstruct and retard the action of the eliminating surfaces and organs of the body. As typical illustrations its effects upon the bronchial excretions when these become so tenacious as to be very obstructive and very difficult to dislodge; and its effects in the removal of goitre and other glandular enlargements and obstructions. It appears to cause the dilution and washing away of condensed or semi-liquid deposits by favorably modifying the action

of the surfaces and cells involved. At least some such view seems to afford the best key to its general use.

As its action is to be a sustained or continuous one, it is best given in moderate quantities frequently repeated, and freely diluted. It is best administered in solution, diluted at the time of taking with very cold water, and the ordinary dose to begin with is about 10 grains three or four times a day. But if no effects are obtained from such doses they may be largely increased. In pharyngeal and bronchial affections the inhalation of sprayed solutions is often very useful.

IODIDE OF AMMONIUM, NITRATE OF AMMONIUM, PHOSPHATE OF AMMONIUM and SULPHATE OF AMMONIUM are salts which are very little used in medicine, and the writer knows nothing about them as elements of the materia medica.

VALERIANATE OF AMMONIUM is the relic of a past fashion lingering along in a few hands, and now most frequently heard of in the form of a once very fashionable and popular elixir, and the elixir seemed always to be most popular when it contained least of the valerianate.

AMYL NITRIS.

NITRITE OF AMYL.

$C_5H_{11}NO_2$; 117. — $C_{10}H_{11}O,NO_3$; 117.

Nitrite of Amyl should be preserved in small glass-stoppered vials, in a cool and dark place.

A clear, pale yellowish liquid, of an ethereal, fruity odor, an aromatic taste, and a neutral or slightly acid reaction. When freely exposed to the air it decomposes, leaving a large residue of amyl alcohol. It is insoluble in water, but soluble in all proportions, in alcohol, ether, chloroform, benzol and benzin. Its sp. gr. is 0.872 to 0.874, and it boils at about 96° C. (205° F.), giving an orange-colored vapor. It burns with a fawn-colored flame. Warmed with excess of solution of potassa it gives the odor of amyl alcohol. If this alkaline mixture be treated with a little test-solution of iodide of potassium, and then with acetic acid to an acid reaction, there is an immediate separation of iodine, and on the addition of gelatinized starch a deep blue color appears (distinction from nitrate). It should remain transparent, or nearly so, when exposed to the temperature of melting ice (abs. of water).

On shaking 10 C.c. of Nitrite of Amyl with 2 C.c of a mixture of 1 part of water of ammonia and 9 parts of water, the liquid should not redden blue litmus paper (limit of free acid).

The Nitrite of Amyl used in medicine under this title does not seem to be the simple substance known as such to chemists, but is

a rather complex mixture or compound of loose molecular structure, and varying considerably with the processes used for obtaining it. It is very much like Spirit of Nitrous Ether in this respect, and therefore to be uniform it should be the product of a uniform process and management.

The best of several processes tried by the writer, and the one which has now been in successful use for many years, is the counterpart of the process for Spirit of Nitrous Ether, and was suggested by, and based upon that process. It is by the direct action of nitric acid upon amylic alcohol, under the conditions of a well regulated temperature.

The apparatus for making it consists of a wide neck distilling flask, fitted with a rubber stopper, with one large and two small glass tubes. One small tube for supplying the acid and the alcohol in a continuous stream as the distillation proceeds. The large tube for the passage of the vapor to the condenser, and the other small tube for the passage back into the flask of the amylic alcohol condensed from the mixed vapors by the lower hot condensers. This flask is set in a glycerin bath, heated by a steam coil from the common steam boiler. The vapor tube of the flask is connected to the upper one of two Liebig's condensers made with glass tubing in iron cases. From the end of the second of these condensers the vapor tube rises perpendicularly, without a case, to the upper one of another similar pair of condensers. From the lowest point of this upright tube, where it is connected to, and continuous with the condenser tube, passes off a small tube which takes the liquid which is condensed by the lower condensers and the upright tube, back to the distilling flask by the small tube in the stopper before mentioned. This small glass tube from the lower condensers back to the flask is bent into a U trap, so that no vapor can pass out by it, but only liquid into the flask. The upper pair of condensers terminate in an open extremity from which the condensed liquid flows into a receiver. The cases of the lower pair of condensers are supplied with steam from the boiler, and are always kept steam-hot. The cases of the upper pair are supplied with cold water. Two bottles, whose joint capacity is about equal to that of the distilling flask, are fitted with corks through which small syphons pass to the bottoms, and small air tubes for charging the syphons. These bottles are placed upon a shelf or support elevated three or four feet above the distilling flask, and the two outer ends of the syphons are connected with a Y tube by short pieces of rubber tubing, each furnished with a

screw pinch cock. The lower single tube of the Y is continued down and connected with the charging tube of the stopper in the distilling flask. By this arrangement the contents of the two supply bottles can be run into the distilling flask in any quantity and at any desired rate, and the contents can be run in separately or together. In the writer's apparatus these are 9 pint bottles, and hold about a day's work for the two gallon distilling flask. One of the bottles is filled with a dilution of 9 parts officinal nitric acid and 1 part of distilled water, and the other is filled with 8 parts of well purified amylic alcohol, boiling at about 132° C.=269.6° F. A mixture, of about one-eighth of the capacity of the distilling flask, is made in it over night, consisting of 1 part of the diluted nitric acid and 2 parts amylic alcohol, and this serves to start the process. In the morning the glycerin bath is heated up until the desired reaction takes place in the flask, and when the boiling becomes active the heat is kept very steady and the feeding in from the bottles is begun, so regulating the current that about 2 parts amylic alcohol to 1 part nitric acid flow steadily in at a rate a little more rapid than the distillation. The more volatile products formed by the reaction carry over to the condensers with them a very considerable proportion of undecomposed amylic alcohol, and other products of higher boiling points, such as nitrate of amyl. The lower pair of condensers, which are kept steam-hot, condense a very large proportion of these substances of higher boiling points, and the liquids are drained back into the flask through the small trapped tube provided for the purpose, while the substances of lower boiling points, such as the nitrite of amyl, aldehyde, etc., are not condensed by the lower condensers, but rise through the upright tube to the upper pair of condensers, and are there condensed by the cold water and run into the receiver. This is the crude nitrite of amyl, and when it has accumulated in any convenient quantity it is well washed by active agitation and digestion upon a solution of crystallized carbonate of sodium, 1 part to 5 of water. It is then returned to the distilling flask and rectified. In the rectification not more than one-third to one-half can be got over with the steam heat of the bath, and the remainder is mainly amylic alcohol. When the rectified nitrite of amyl ceases to come over, the receiver is changed and nitric acid is run into the flask from the bottle until this residue of amylic alcohol is reduced to about one-half, when fresh alcohol is again run in with the acid and the process carried on as before, until another portion of the crude nitrite is obtained for washing

and rectification. The bottles containing the accumulated rectified product are then set out of doors in winter, or in an ice bath in summer, when in about 12 hours the dissolved water will be precipitated out and may be easily separated.

This apparatus and process yields an excellent medicinal product which has now been largely used for more than ten years past, but it is not free from the accidental products of the reaction, and does not agree well with the Pharmacopœia description nor answer to the potassa test. So far as can be ascertained by the writer, three manufacturers of nitrite of amyl supply nearly or quite all that is sold in this market. Two of these makers are domestic and one foreign. That of foreign make is imported in sealed glass tubes of one ounce each, and this is the only practicable way yet devised of handling the liquid without serious loss. But the sealed tube has some rather serious disadvantages which prevent this writer, and perhaps other makers, from adopting it. In opening the tubes skillful management is required, and even with the greatest care there will be some loss and some little danger. The diffusibility, or vapor tension, of the liquid is so great that a very considerable pressure is generated in the tubes, and it is this pressure which causes the difficulty. The best way of opening them was found to be, after chilling them well for 10 minutes in ice-water, as follows: The tube should be held in a towel so that in case it breaks the glass will not cut the hand, or fly in the face. The neck of the small projecting part of the tube is laid against the edge of a table and is nicked with a sharp file opposite to the edge. Then a smart tap with the file, outside the neck, breaks off the little nipple. In doing this the tube should not be pointed toward a window, or a person, because the little piece of glass flies off with an explosion and often with force enough to break a window. In one tube out of 17, in the writer's hands, the glass went all into small pieces, and cut the hand which held it, in two or three places, thus suggesting the necessity for wrapping with a towel, and of the use of an ice-water bath. Another of the tubes would certainly have gone in the same way but for the ice-water bath. When the nipple is off a very small opening is left, through which it is quite difficult to empty the tube. The best way to get the liquid out is perhaps to pass a long platinum wire through the opening, and inverting the tube over a narrow beaker, churn it up and down until empty. The device of wrapping the tube in a cloth wrung out of hot water was not tried. Some three hours' time was required in emptying 17 one ounce

tubes, and the loss was about 2 ounces. It therefore appears that stoppered vials are the best means of transporting the liquid, although the loss by them is much greater through gradual leakage of vapor, with the best possible stoppering.

The product of the other two manufacturers is put up in one ounce ground stoppered vials, and from the great difficulty in getting stoppers ground in large quantities so as to retain this liquid the vials are occasionally found empty after transportation, and are often found only partly full. Indeed it is doubtful whether any glass stopper can be made to hold the liquid perfectly, so that after long transportation, especially in summer time, every single vial will be found somewhat short, but a few with a larger shortage than others. As a rule it should never be ordered for any long transportation in summer, and those who cannot foresee their wants sufficiently to avoid such transportation should bear the losses that occur through this want of foresight. It is neither a very difficult nor costly substance to make as found in the markets, and could be sold at much lower price were it not for the cost of stoppering the vials, and of making good the losses when the bottles reach their destination empty. Lately, by extraordinary care in grinding the stoppers, and by the use of a very minute quantity of soft white paraffin on each, the losses have been reduced somewhat, and the stoppers made rather easier to get out. Of all liquids it is perhaps the most difficult to transport without loss. No material except glass will answer for it, and the vapor which stands over the liquid has such a tendency to decompose that, in common with Spirit of Nitrous Ether, it acts upon cork very speedily. However well stoppered, any package of the vials is almost sure to give the odor, and any packing box containing a package of the vials, will, after transportation, give the odor, even when the leakage is at its minimum. It is very rare indeed that the liquid leaks out, and even when bottles reach their destination empty there is usually no staining of the wrappers, and the bottles appear as though put up empty. Therefore, when bottles are transported upside down, as must frequently be the case, when the pressure generated can only push the liquid out instead of the vapor, it must escape so slowly as to evaporate as fast as it gets through. It is in consideration of these characteristics that the Pharmacopœia wisely directs it to be kept in glass-stoppered bottles in a cool, dark place, and when thus cared for it keeps indefinitely.

In the examination of the products of the three manufacturers

who have so long supplied the chief, if not the entire, demand for this substance in this market, the results are given in the supposed order of the quantities sold. That is, the nitrite of amyl supposed to be sold in much the largest quantity is called No. 1. That sold in the next largest quantity No. 2, and that sold in smallest quantity No. 3, and the prices at which they are sold differ by about 4 cents an ounce. One of the makers, namely, this writer, puts up fluidounces, while the other two put up avoirdupois ounces by weight, and thus give nearly one and an eighth fluidounces, or over 10 p.c. more to start with.

No. 1 was a pale yellow color, hardly deep enough for straw color.

No. 2 was a full yellow, too deep for straw color, and yet hardly a deep golden yellow.

No. 3 was hardly distinguishable from No. 2, in either kind or depth of color; a shade or two lighter perhaps when seen in quantity of 500 c.c.

All were faintly acid to neutral litmus paper when looked at while the paper was immersed, the reaction becoming more acid on exposure to the air. But No. 1 was most acid and No. 3 least so.

When 5 c.c. of each was exposed on a watch-glass, the watch-glasses standing side by side, at the end of six hours No. 1 had a considerable residue of liquid, No. 3 a much smaller quantity, while in the case of No. 2 the glass was merely greasy.

The apparent	s.g.	of	No.	1	at	4° C.,	compared with water at	4° C.,	was ·8572
"	"	"	"			15° C.,	" " "	15° C.,	" ·8487
"	"	"	"			15.6° C.,	" " "	15.6° C.,	" ·8483
"	"	"	"			25° C.,	" " "	15° C.,	" ·8405
"	"	"	2			4° C.,	" " "	4° C.,	" ·8904
"	"	"	"			15° C.,	" " "	15° C.,	" ·8794
"	"	"	"			15.6° C.,	" " "	15.6° C.,	" ·8788
"	"	"	"			25° C.,	" " "	15° C.,	" ·8691
"	"	"	3			4° C.,	" " "	4° C.,	" ·8915
"	"	"	"			15° C.,	" " "	15° C.,	" ·8809
"	"	"	"			15.6° C.,	" " "	15.6° C.,	" ·8803
"	"	"	"			25° C.,	" " "	15° C.,	" ·8707

At 15° C., they were respectively, ·8487,—·8794, and ·8809. From these results, when taken in connection with what follows, it will be seen that specific gravity, although a useful guide, is not an indication of quality which can be relied on when taken alone, since No. 2 is better than No. 3, although slightly lower in specific

gravity. By far the most common contamination, as in No. 1, is unchanged amylic alcohol, and as this has at 15° C. a s.g. of about ·815, and a boiling point of 132° C., it follows that the more of the alcohol present, the lower will the s.g. The next most common contamination is likely to be nitrate of amyl, s.g. about ·998 to 1.000, boiling at about 148° C., and the presence of this would have the contrary effect of increasing the s.g., while admixture of the two contaminations would yield intermediate s.g., and thus make s.g. an uncertain test when the boiling points by fractional distillation be not also taken.

When all the specimens were contained in one ounce vials equally filled, and of about the same size at the mouth, if one nostril was applied and the other stopped and a moderately full inspiration taken, they all gave the characteristic sensation of fulness of the head within a few moments, but No. 1 gave decidedly less fulness than the others. From a half inspiration, the fulness from No. 1 was still perceptible, while from No. 2 it was quite strong, and from No. 3 slightly weaker. When still less of the vapor was inhaled there was no effect from No. 1, while the others were very distinct, but No. 3 less strong than No. 2. In these trials 10 to 15 minutes' time was allowed between each, for the effects to go entirely off. As a result of the trials it was estimated that one-fourth of an inspiration from No. 2 was equal to a moderately full inspiration of No. 1, and that No. 3 gave about three-fourths of the effect of No. 2. No. 1 gave an inclination to cough, very similar to that given on smelling amylic alcohol, the others giving this tendency in a smaller degree, or generally not at all.

In testing these products by fractional distillation it was found that satisfactory results could not be obtained from small quantities, and therefore 500 c.c. of each was taken for parallel distillations. These were made from an ordinary glass retort, the tubulure of which was fitted with a good thermometer, with the bulb as near as practicable to the bottom. The heat was applied by a bath of diluted glycerin. The retort was connected to a good Liebig's condenser by rubber connections, and the lower end of the condenser was reduced in size so as to be always closed by the drops of liquid and so as to pass inside of the receiving vials. The distillate was received in fractions of 5 to 6.5 p.c. of the original quantity, and the distillations were conducted as nearly as possible alike in every way. All had the appearance of boiling before real ebullition began, but it was easy to see when condensable vapor was produced, and from

this point the boiling in each case was uniform and steady throughout. After the distillation commenced there was apparently no uncondensable gas or vapor produced.

The results of the fractioning were as follows:

	Began to Boil at	Began to Distill at	Per cent. of Distillate over at 95° C.	Per cent. of Distillate over at 98° C.	Per cent. of Distillate over at 100° C.	Per cent. of Distillate over at 105° C.	Per cent. of Distillate over at 110° C.	Per cent. of Distillate over at 120° C.	Per cent. of Distillate over at 136° C.	Per cent. of Residue in Retort at the Close.
No. 1.	87° C.	89° C.	6.6	.....	.....	13.2	19.2	35.8	86.0	10.4
" 2.	61°	85°	19.2	34.4	45.6	66.6	77.8	84.4	*90.2	7.6
" 3.	63°	93°	.....	2.0	5.0	33.4	57.4	81.2	89.2	6.8

*The temperature in the distillation of No. 2 never rose above 128° C.

The above given percentages are all by volume, and the difference between the sum of the last two columns and 100 is the loss in distilling.

Now when it is remembered that amylic alcohol boils at about 132° C., and that the reaction between this alcohol and nitric acid under the prescribed conditions yields chiefly nitrite of amyl, boiling at about 96° C., but also an aldehyde boiling at about 21° C., and nitrate of amyl boiling at about 148° C.,—the results of the fractioning will be understood. Most authorities describe nitrite of amyl as though it distilled with a constant boiling point; W. Hofmann, however, as quoted by Gmelin, Vol. XI., p. 63, says that it begins to boil at 90° C., the boiling point rising slowly to 110° C., and then more quickly to 200° C. And Allen, Commercial Organic Analysis, 1879, Vol. I., p. 160, says when submitted to fractional distillation at least 80 p.c. of a good sample will pass over between 90° and 100° C. This having no fixed boiling point, seems to indicate a substance of loose composition which easily splits up under the effects of heat, and probably reunites on cooling. In the fractioning of sample No. 2 about 5 p.c. of the original quantity came over for each rise of 1° C. in the boiling point, between 94° and 104° C., the fractions being larger at first and smaller toward 104°.

Then they gradually decreased to 4 p.c., 3 p.c., 2 p.c., and 1 p.c. for each rise of 1° C., and the boiling point did not go beyond 128° C. when the distillation was stopped with the thermometer bulb only about half immersed and about 38 c.c. left in the retort. But only about 46 p.c. of this specimen came over below 100° C.

On comparing the 16 fractions of this distillation there was but little difference in color throughout, the residue from the retort being nearly as deep a yellow as the first fractions, but not quite as deep. All were of a full yellow and not pale yellow. The difference in odor and in effect was greater than in color. No difference was perceptible between the first 10 of the fractions, and even in the next 4 the difference was slight. The last or 15th distillate gave the characteristic sensation in the head from a half inspiration, and did not produce cough. But the 16th fraction or the residue from the retort gave but a faint sensation in the head, and produced the cough which is characteristic of smelling amylic alcohol. From these observations it seems very probable that the splitting of the nitrite begins at the first boiling point and continues throughout, and that the result is a compound which contains less amylic alcohol, and from having a lower boiling point distills over, leaving a compound of more amylic alcohol and higher boiling point which remains behind. This is evidently what occurs on exposure in a watch-glass, when the residue is very much like that from the retort. It is probable therefore that this specimen No. 2 was nearly all nitrite of amyl at the start, the proportion of partially combined, or loosely combined amylic alcohol being less than 10 p.c., and the proportion of nitrate of amyl less than 5 p.c., while the aldehyde must have been in very small proportion indeed.

The specimen No. 3 seemed very much like No. 2, though yielding very different results upon distillation. Only about 5 p.c. of this specimen came over below 100° C., or less than 1 p.c. for each rise of 1° C. But between 100° and 105° about 28 p.c. more came over, or about 5.5 p.c. for each rise of 1°. And only about 57 p.c. came over below 110°. At 120° there was over about 81 p.c., or only about 3 p.c. less than from No. 2 at this temperature, but the next fraction and the residue had much higher boiling points than No. 2.

On comparing the 16 fractions of No. 3, all were of a full yellow color throughout, though slightly paler than No. 2, and the difference in shade between the first and last fractions was slightly greater than in No. 2. The first three fractions came over opalescent, and on standing minute drops of water collected upon the sides of the vial, leaving the liquid transparent. There was no discoverable difference in effect between the fractions of No. 3 and No. 2, until about the 8th fraction was reached, but from about this point there was an increasing difference to the end, and the last 3 distillates

and the residue from the retort were all more feeble in effect, and gave cough, from a larger proportion of amylic alcohol. From these considerations it seems probable that No. 3 was nearly equal to No. 2, the chief difference being that it had a larger proportion of amylic alcohol, and nitrate of amyl, and a smaller proportion of aldehyde, and contained a little water; and these would fully account for its slightly weaker physiological effect.

Specimen No. 1 was very different from the others. It was distilled in 13 fractions, the residue in the retort making 14. The color of the original liquid was pale yellow, much lighter than the other specimens, and the first fractions were of a considerably deeper color, diminishing in color so that the original paleness of color was not reached until about the 7th fraction. From this point the color diminished more rapidly to the 10th fraction, when the distillate became practically colorless; but the 14th fraction, or residue, from the retort was of a deep reddish yellow or orange yellow color, different both in kind and in degree from any of the fractions of any of the specimens. The first 4 fractions came over very opalescent, and from the first of them about one-sixth of its volume of water separated out. From this the proportion of water diminished to the 4th, and disappeared from the 5th fraction.

The difference in odor and effect on the head was quite as marked as in the color. The first 3 or 4 fractions were moderately prompt, but feeble in effect as compared with Nos. 2 and 3, and after the 4th the effect was very feeble, exciting cough after the 7th in an increasing degree.

From these circumstances it would appear that No. 1 is of very inferior quality, and quite unfit for medicinal use, and yet it is probably sold as nitrite of amyl in larger quantity than both the others together.

When each specimen was mixed with an equal volume of officinal solution of potassa, the solution in 5 minutes was of a full yellow color in Nos. 1 and 3, and of a deep brown color in No. 2, and on standing 48 hours the No. 2 gave a light precipitate, probably of aldehyde resin. No. 2, therefore, contains the largest proportion of aldehyde, the others containing very little.

Each specimen warmed with excess of solution of potassa and then treated with a few drops of test solution of iodide of potassium, and with acetic acid to acid reaction, gave a blue color with starch paste, and would do so if only the very smallest proportion of nitrite was present. This test does not detect the presence of

nitrate of amyl at all, but merely tells whether the liquid contains any nitrite or not. If the liquid was wholly nitrate,—that is, free from any trace of nitrite, the testing would be negative,—no blue color would be produced. It would be an excellent test for the presence of nitrite of amyl in the nitrate, but is quite useless for testing the nitrite. The nitrate is much more difficult to make than the nitrite, and it is very difficult indeed to get it so free from nitrite as to stand this test. Hence there is no danger of its being substituted for the nitrite in so pure a condition as to stand this test. But if so substituted it would be recognized at once from its being colorless,—from having a very different odor, and no effect upon the head. What is really needed here is a test for small proportions of nitrate when accidentally contaminating the nitrite, and the writer knows of no such test that is better than the boiling point, and yet a specimen may actively boil at 96° C. or below it, and yet have a considerable proportion of nitrate accidentally present. And a specimen containing a considerable proportion of nitrate may distill completely long before the temperature reaches the high boiling point of the nitrate.

Nos. 1 and 3 did not stand the excellent test for absence of water, as both were opalescent in ice-water, though No. 3 was but slightly opalescent, as is permitted by the Pharmacopœia.

The limit of free acid was not passed by either specimen, but the test for free acid is not easy to apply properly, because the nitrite when quite neutral becomes rapidly acid on exposure to the air. The solution of ammonia should be put into the tube first, and a small piece of litmus paper dropped into it. Then the nitrite is added and the mixture well shaken. The litmus should then remain blue. But on standing a little while it will become red, and require a few more drops of the dilute ammonia to restore the blue color, and this may be repeated time after time. And if while the litmus remains blue, another piece wetted with water, be held in the air of the tube over the liquid it will be promptly reddened by the vapor.

It has been mentioned that good glass-stoppered vials of one ounce capacity, the stoppers being ground in with extraordinary care, and the ground surfaces being slightly lubricated by a very minute quantity of soft white paraffin,—are the best containers for this very difficult liquid; but there is another way of transporting and dispensing it that is well worthy of attention. It is not uncommonly put up and sold in the form of "Pearls of Nitrite of

Amyl." These pearls are minute flattened flasks, with rather long necks, the end being sealed in the lamp after the little flasks are filled. They are of various sizes, containing either 2, 3, 5, 8, or 10 drops of the nitrite. Formerly they were made of very thin glass, so as to be crushed by the fingers when held in the fold of a handkerchief. But when so thin as this a large proportion of them were lost by spontaneously bursting. This naturally created great dissatisfaction to buyers and a strong prejudice against them. Now, however, they are made of much thicker glass and cannot be broken by the fingers, and the spontaneous bursting is now comparatively rare. But they now require some hard substance to break them. Enclosed in the folds of a handkerchief, and laid upon a table, a smart blow with a closed pocket knife is sufficient to break the glass and liberate the contents for use. They are sold by the dozen, or by the hundred as ordered, packed in cotton, in pasteboard boxes. One house sells them in boxes of one dozen each, and each box contains what is called a crusher. This consists of two small turned wooden boxes, one inside the other. The inner box holds two or three pearls, and between the bottom of the inside box and the bottom of the outside one, is carried another pearl surrounded with a little cotton. This crusher is intended to be carried about the person, and when the effect of the nitrite is needed the lid of the outside box is taken off, and the inside box is forced down upon the pearl beneath it so as to crush it and allow the liquid to be absorbed by the cotton. The inner box is then taken out and the vapor inhaled from the outer box. This is much better than inhaling it from a handkerchief, because the diffusion is so rapid from the latter that it is difficult to get the vapor into the lungs in a sufficiently concentrated state, or to get enough of it before it is dissipated. Inhaled from the tuft of cotton in the box it is about as good as if inhaled from a bottle, the vapor being quite concentrated and in sufficient quantity for any ordinary use from a 3 drop pearl. If to be inhaled from a handkerchief a 5 or an 8 drop pearl is better. The chief objection to these pearls is that there is no security for the quality of the contents except the maker's label on the box, and the maker of the pearls has to rely for his security on the maker of the liquid. Then the liquid, by the necessary exposure in measuring off and filling each pearl, doubtless is somewhat damaged, and by ignorant or careless management might be very much damaged. These pearls are now dispensed originally by two houses in New York, from whom most if not all the dealers get them, and from an

examination of the pearls from the two sources they appear to be identical, so that it is probable that one expert fills them for both firms. The contents of the pearls from both firms were examined and found to be identical as far as could be ascertained, and the nitrite was of good quality,—much better than specimen No. 1, and quite as good as No. 3, though it appeared to be not quite as good as No. 2, which latter however it strongly resembled when submitted to the same tests. There is every probability that the pearls were filled from No. 2, but that the quality had slightly fallen off in the necessary exposure in filling; but the amount of falling off was practically unimportant.

Another secondary objection to the pearls is their comparatively high cost. The expense of the glass and of the expert skill required in filling and sealing, and the accidental losses by bursting and by small cracks in the glass, are necessarily great,—probably far greater than the cost of the liquid, so that it takes comparatively few of the pearls to be equal in cost to an ounce vial of the liquid. Nevertheless, they are very convenient in use, and nicely applicable to some cases, where the expense is hardly an objection so long as the quality of the contents can be assured.

By far the most economical, and perhaps the best way of using it, is to buy it in ounce vials, and from such a vial to replenish as often as may be needed, a very small pocket vial, stopped with a good cork, that is occasionally renewed. The pocket vial should be small and strong to avoid breakage in the pocket,—say a 30 minim vial with as large a mouth as possible, and this should be about half filled. The vapor should always be inhaled from the vial,—at least there are very few cases in which a sufficient effect cannot be obtained by smelling at the mouth of the vial with one nostril, the other being closed, and the wider the mouth of the vial the more vapor is obtained in this way. The few cases that cannot get enough vapor directly from the vial may carry a piece of glass tubing corked at both ends, and containing a little tuft of cotton upon which about 2 or 3 minims of the nitrite is dropped. When both corks are removed and the air gently drawn through the tube by the nostril, a very concentrated vapor is easily and quickly obtained. Two inspirations from the mouth of a 30 minim vial is sufficient to flush the writer's face and increase the pulse rate by 40 beats, and the effects pass off within a minute and a half, excepting the pulse rate, which diminishes less rapidly. A third inspiration ten or fifteen seconds after the two, very considerably in-

creases the effect of the others, both in degree and duration, and gives about all the effect that is needed in a large proportion of cases. Twenty such administrations does not appreciably diminish the quantity of liquid in the vial, but does affect the quality somewhat, so that from time to time, as the effect is observed to become weaker, it is better to throw away the residue in the pocket vial and resupply it from the stock in the ounce vial. This latter vial should always be kept in a cool, dark place, as directed by the Pharmacopœia.

Nitrite of amyl is almost exclusively used by inhalation, and for a prompt and temporary effect in emergency, and hence the great importance of its being of good quality and in readiness for instantaneous application. Its prominent effect is to suddenly and temporarily relax or paralyze the muscular coats of the arteries, thus suddenly dilating these vessels. This practically diminishes the resistance against which the heart, as a force-pump, has to act, without diminishing the power which, for the time, is applied to the heart. Thus relieved of resistance while the power is continued, the heart beats faster in proportion to the relief, until at a later stage, when, if the nitrite be continued, the power applied to the heart becomes lessened and its rate diminished to the new conditions. In a large proportion of the uses of the nitrite this second stage is to be avoided as useless, if not hurtful, so that when the desired results are not obtained from the full effect suddenly produced by a few inhalations, it is best to withdraw the agent entirely for a short time, and then repeat with an increased dose if desirable.

When the administration is of short duration it is not easy to overdose it, because the effects pass off so very rapidly ; and most of the harm which has been done by it seems to have been by continuous administration, so as to intensify the after stage of general depression. The writer once accidentally broke a flask by which about 2 pints ran over the table and floor of a small room, and as it was necessary to get at some gas burners and put them out before the vapors took fire, he was exposed for many seconds to a very concentrated vapor. The effect was exceedingly sudden and great. Not only the head but the whole body seemed to swell as though it would burst, and although consciousness was not disturbed, and the necessity for getting out of the room all the time fully recognized, yet the power to walk seemed very nearly lost as the door was passed and a seat outside was reached, yet the effect passed off in a very few minutes, leaving merely a headache.

It thus appears that nitrite of amyl is simply a powerful temporary disturber of the heart and arteries, and through the perturbation caused by it a sudden supply of blood may be taken from the venous system and thrown into the arteries. It is easy to understand how so profound a disturbance, so suddenly induced, may interrupt and reverse any abnormal condition which is commencing, in which contraction of the capillary arteries has either a primary or secondary agency. For example, if the epileptic seizure begins by a local anæmia in the nervous centres, it is easy to understand how nitrite of amyl may interrupt and reverse this, and thus prevent the seizure whenever the effect can be induced in time, and thus the statement to the writer of the Superintendent of one of the largest hospitals for the insane in the world can be easily understood. The statement was, in effect, that since his nurses and attendants had been trained to the proper use of nitrite of amyl, his epileptic wards had been revolutionized for the better ; and farther, that by continued prevention of the seizures the habit of recurrence was broken, so that in many cases a curative effect was obtained from an agent not at all curative in itself, and of mere momentary action.

From the same considerations it is easy to understand how the cold stage of paroxysmal fevers may be interrupted and aborted by the nitrite, while the cold stage of collapse is not benefited, but injured by it. So in the heart-stasis of one of the fatal forms of chloroform poisoning, if the nitrite can be applied before the cardiac syncope is complete, the diminution of the resistance to the heart's action may, in its feeble condition, enable it to make the few pulsations needed to restore the centres of inervation and thus prevent death.

Almost all the cases of pure spasmodic asthma which occur suddenly, and a large proportion of the cases of angina pectoris are relieved by nitrite of amyl by a similar rationale, and the amelioration of spasm in tetanus has a similar explanation. There appears to be some relation between the suddenness of the attacks and the usefulness of the remedy, since in the records of its application it is rarely of use in conditions which come on slowly, or, it may relieve for the moment only. Thus only a few neuralgias, and those of the spasmodic kind, appear to be relieved by it for any considerable length of time.

It has occasionally been given by the stomach and by hypodermic injection in doses of 3 or 4 minims at a time. But when taken

into the stomach it would have a different effect, and be applicable to a different class of uses. Hypodermically given it has proved effective when respiration was either wholly or partially suspended, so that its effects could not be reached by inhalation.

The preparations of ANTIMONY seem to be rather rapidly going out of use in medicine. There are five of them in the Pharmacopœia, and only one of these, namely, Tartar Emetic, appears in Dr. Bolles' analysis of 3,726 prescriptions, and this one appears 11 times; Compound Syrup of Squill, in which it is a principal element, occurs 6 times. But Antimonial Wine does not occur at all.

Nor does Pulvis Antimonialis,—the only preparation from Oxide of Antimony,—occur at all in Dr. Bolles' lists.

Twenty years ago, even, antimonials were much more largely used, and in looking for the cause of their disuse, it may be supposed that it is due less to their harshness of action, and to the change in the character of disease by the abuses of modern civilization, than to the circumstance that other agents have been found that are better adapted to the uses to which they were applied. However this may be, it is quite rare to see them mentioned in modern medical literature, and very small quantities of them are sold by druggists.

HYDROCHLORATE OF APOMORPHINE is one of the new preparations of the present Pharmacopœia, but it is very little used and of doubtful general utility. The two principal objections to it are, first, that it is uncertain, harsh and dangerous in its action, and probably has as many casualties charged against it, considering its limited use, as any remedy proposed within the past 15 years. Secondly, it is unstable in composition, and especially liable to change, and become partially or wholly inert by keeping.

Its single point of value seems to be that it is a prompt, though not very certain emetic, whose action is said to be directly upon the nervous centres, and not reflex. Therefore, when given hypodermically, it will empty the stomach by emesis, provided the nervous centres are still sensitive to its action. This peculiarity of action is supposed to adapt it to the evacuation of all poisons from the stomach, except the narcotics in the later stages of their action.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND

COLLATERAL INFORMATION.

VOL. II. JANUARY, 1885. No. 7.

HYDROCHLORATE OF COCAINE.

OR MURIATE OF COCAINE.

Since the short account given in the last pamphlet of the new local anæsthetic, the whole of the writer's available time has been given to the subject, with some results that are worth publication.

The name of the salt brought so suddenly into prominent use has been liberally discussed, and the views of many eminent chemists of the country upon it have been published. The writer is not sufficiently acquainted with the chemical philosophy of modern nomenclature and notation to form an intelligent opinion upon the subject, and therefore has no theory to present in support of any name. The fact that more than twenty good authorities, among whom are some of the most prominent chemists of the country, have given their opinions without any great degree of unanimity, and with the suggestion of five or six different names—shows that there is no universally accepted principle or basis of nomenclature upon which the names of such salts can be accurately constructed; and it farther shows that the names which come nearest to accuracy of expression, according to modern views, are longest, most complex, least convenient and least euphonious, and, therefore, are least adapted to common use. Each hypothesis of the yet unknown construction of the molecule of the salt requires a different nomenclature, and gives room for many well-supported names, but all that can be justly claimed, up to this time, is, that some names are less objectionable than others; and that leaving out those which are least objectionable in point of scientific accu-

racy, though most objectionable for common usage by reason of their inconvenience, the name Cocaine Hydrochloride is preferred by most chemists. Prof. H. B. Hill, of Harvard, however, says that while he never uses such names as hydrochlorate without mental protest; yet any departure from well established usage is to be deprecated, unless it be to gain very obvious practical advantages. Then, as there is no very obvious practical advantage to be gained from a change, and as most standard authorities give hydrochlorate, the writer prefers to adhere to the established name, especially in view of the expectation that the true construction of the molecule of these salts of the alkaloids with hydrochloric acid, will sooner or later be shown beyond question, and this might require a change from any name now adopted. It is, however, certainly time to abandon the very old nomenclature by which such salts are still often called muriates. It may possibly aid the chemists in the study of cocaine to know that it probably has two definite hydrates, and two crystalline salts with hydrochloric acid.

A process by which to obtain a salt of cocaine for use, seems now to be of far more importance than a change of name, and it is probable that the salt with hydrochloric acid at present generally used, is the best, first, because it forms a salt with the largest proportion of alkaloid, and is easily crystallizable with the smallest proportion of water; and, secondly, because it is very soluble and but slightly, if at all, deliquescent. The salicylate is said to be a very good salt, and solutions of it would be likely to need no protection in keeping, but the high combining number of the acid would give a much weaker salt and one that is probably much less soluble. Therefore, for the present, at least, the hydrochlorate appears to be the preferable salt.

Up to the time of the last note on this subject (see page 685), a modification of the process of Lossen for extracting the alkaloid was found to be least objectionable, but on increasing the scale of its application difficulties were soon met with, and it was found that much of the alkaloid was split up and lost. In short, it was found that this and some other processes yielded more benzoic acid than cocaine, and many losses and disappointments occurred in learning the important lesson that the alkaloid, when set free from its natural combinations in the leaf, was split up, or decomposed at a comparatively low temperature, yielding benzoic acid and an alkaloid or glucoside, or both, that contained no cocaine, or only traces. In the search for less costly solvents than alcohol and ether, it was

found that amylic alcohol did very well under certain conditions. The ground or unground leaves, moistened with solution of carbonate of sodium in water, and then dried at very low temperatures, were easily exhausted by means of amylic alcohol, the free alkaloid being very soluble in this menstruum. Moistening with dilute solution of caustic soda, both in water and alcohol, and drying, was tried. These also were easily and probably completely exhausted by amylic alcohol in the cold, but a large quantity of the menstruum was required, and the washing out of the alkaloid by acid water was laborious and troublesome, and gave the alkaloid in a dilute and voluminous solution that was necessarily very acid, since if the water was not strongly acidulated it did not separate well. And if too strongly acidulated it was dissolved to a clear solution by the amylic alcohol.

The advantages, however, were that the alkaloid washed out of the amylic alcohol as a sulphate, was comparatively free from color, giving but little trouble in decolorizing, and the amylic alcohol was recoverable by distillation, with a very small loss, and in a perfect condition to be used again. The tedium of drying at so low a temperature, before the exhaustion, and the laborious washing of the percolate, caused the solvent to be abandoned, although it deserved a more careful investigation, and after many other trials and vexatious disappointments and very much loss of time and valuable material, the following modification of the original process of Nieman was reached, and has proved quite successful.

Unmodified, Nieman's process had already failed several times when used on any considerable quantity of material, so that it had been passed as impracticable. His process of assay was also found to be defective, and therefore it is unnecessary to give the process, especially as the steps adopted here from them were not original with him, but were commonly applied to other alkaloids at the time of his investigation. A good abstract of his process may be found in the English edition of Gmelin's Handbook, Vol. XVI., page 301.

A convenient scale for the extraction of the alkaloid is to take for each operation 45 kilos or 100 pounds of the ground leaves, passed through a No. 20 sieve (20 meshes to the linear inch). This powder is moistened with an equal weight of alcohol of about 92.5 p.c., to which has been added one fifty-eighth to one-sixtieth of its weight of sulphuric acid of a s. g. of 1.483. That is 12 grains of the acid to each pound of the alcohol. The moistened powder is packed firmly in a stone-ware percolating pot, and the process of

repercolation is applied to it as given in detail at page 608, as applied to tea, only that the portion of weak percolate used to moisten the second and every other succeeding portion of 100 pounds is acidulated in the same way that the first portion of alcohol was, before it is poured upon the powder. The first or strong percolate of the first two portions may be taken together when they represent about 100 pounds of the powder, and the alcohol recovered from them by distillation for use again in continuing the repercolations. If the process of repercolation be not applied, but each 100 pounds be exhausted and completed separately, the quantity of alcohol required for complete exhaustion is about five times the weight of the powder, and the loss of alcohol in the process is from 25 to 30 p.c. under the best management. But by repercolation the loss may be reduced to less than 20 p.c. When the alcohol is all distilled off the still is uncovered and 10 pints or 4750 c.c. of water for each 100 pounds of coca represented, is thoroughly mixed with the hot liquid extract. The whole is then transferred from the still to a glass jar and allowed to become cold. It will then have separated into an upper almost black stratum of chlorophyl and other extractive matter insoluble in water, and a lower, watery, acid solution containing the sulphates of the alkaloids. This watery layer is drawn off by a syphon into a filter, and filtered into a bottle of about three times the capacity of the liquid. The extractive matter is then again washed, by agitation, with about two pints or 950 c.c. of water, and separated as before, the watery portion being added to the first. Add to this about one gallon or 3800 c.c. of stronger ether and then a considerable excess of carbonate of sodium—about 10 ounces or 284 grammes of the crystals for each 100 pounds, or 45 kilos of coca. Shake this mixture well, allow it to separate, syphon off the lower, watery solution, and wash this again by active shaking with a second gallon of stronger ether. Draw off the liquid and repeat the ether washing a third time. Collect the ethereal solution of the alkaloids in a flask placed in a water-bath, and recover the ether for use again. Dissolve the ether residue of alkaloids in water acidulated with sulphuric acid in the proportion of 12 grains to the pound, or ·17 p.c., using enough to make the solution decidedly acid. Shake this acid solution of the alkaloids with about one-fourth of its volume of stronger ether repeatedly, until the ether comes off colorless or nearly so. Then precipitate the solution again with carbonate of sodium in the presence of ether, as before, washing the mother waters with ether

by shaking in the same way. Collect the ethereal solution again in the distilling flask, and again distill off the ether to about two pints or 950 c.c. to the 100 pounds, or 45 kilos of coca. Transfer this to a tared beaker while hot, and set it in a warm place until the remainder of the ether has evaporated, stirring frequently to prevent the crystals from forming in a solid mass or cake. If the crystals be kept in a loose, granular condition by this stirring, they are easily dissolved without much loss of time, but if allowed to form in a solid mass they are very difficult to dissolve. A brownish yellow mass of loose crystals of crude alkaloids will remain, weighing—according to the quality of the coca used—from 100 to 200 grammes to the 45 kilos or 100 pounds of coca, if the drug has not been below a fair quality, as determined by an assay before being bought. Pour onto this mass of crystals about half its volume of water, and then add concentrated sulphuric acid in the proportion of about 12 c.c. to each 100 grammes of crystals, with constant stirring until the crystals are dissolved, and the solution is very slightly acid. Then dilute the solution to about five times the weight of the crystals.

Then arrange a cylindrical percolator of such capacity as to be about half filled by a weight of moist, purified and well-washed bone-black equal to the weight of the crude alkaloid, and filter the solution through this at a rate not faster than about ten to fifteen drops per minute,—the slower the rate the more perfect the decolorization will be. But the bone-black used must be of good quality,—and of such quality as it is almost impossible to get without making it. The writer is very much indebted to his friend, Mr. P. Casamajor, for lifting him out of the bone-black Slough of Despond. Good effective bone-black must be pure carbon in the peculiar state of aggregation given by the burning and washing. It should be perfectly black in color, and when boiled with dilute solution of caustic potassa should yield a colorless supernatant liquid. If not well burned the liquid will have a brown tint. Burned from a platinum foil it should leave no residue, or merely traces. It should be in fine powder, and after being well washed, first with hydrochloric acid and then with water, it need not be dried, but simply be drained and kept in a moist state for use. Bone-black bought in the market at $1 per pound, and labelled chemically pure, proved very inefficient until re-burnt; whilst good sugar-house bone-black when re-burnt and washed was much more effective. For decolorizing so valuable an alkaloid the bone-black

must be simply pure carbon, for that absorbs the smallest amount of the alkaloid, and gives up no foreign matter to the solution filtered through it, and the solutions subjected to its action should be rather dilute,—say, one in five, and be either neutral or slightly acid. The solution should come through this percolator quite colorless at first, and when all through and the black washed clean with about four times its volume of water, the entire solution and washings should be not deeper than a full straw color. This will be the result if the bone-black be of good quality, and in an active condition; but it is worthy of note that a bone-black may answer the tests by caustic potassa and by burning without residue, and yet have a very feeble decolorizing power. The bone-black after use is not thrown away, as it contains much alkaloid, which can be extracted by digestion and agitation with carbonate of sodium solution and ether. By the use of a larger quantity of black the whole solution might be obtained colorless, but the loss by the use of bone-black is very considerable and is proportionate to the quantity used, and the farther decolorization is not, at this time, worth the cost of obtaining it, because the coloring matter is inert and unirritating, and when in so small a proportion as to give only a yellow color it does not practically affect the weight of alkaloid. The dazzling whiteness of some salts of the alkaloids, such as those of morphine and quinine, is very beautiful, but desirable only from an æsthetic point of view, since it adds nothing to the effects of the salts. Indeed, the processes by which it is attained are often, if not generally, damaging to the alkaloids.

When the solution has all passed through the black and the latter has been washed with about four times its volume of water by percolation, the whole decolorized solution and washings are collected in a bottle, and solution of carbonate of sodium, one part crystals in five of solution, is added, a small portion at a time, with active shaking between the additions, until the contents of the bottle remain permanently quite opaque from precipitated alkaloid, requiring about 30 c.c. of carbonate of sodium solution to the 100 grammes of crude alkaloid. This first precipitation consists mainly of the useless and inert alkaloid,—the hygrine of the coca, and to separate it the opaque solution is actively shaken with one-sixth to one-eighth of its volume of stronger ether. This dissolves all the precipitated alkaloids,—cocaine as well as hygrine, but a large proportion of the ether is dissolved by the watery solution, and this portion probably holds a share of the alkaloids. The ethereal

solution is then separated, and the ether washing repeated, using about half the quantity of ether the second time. These ether washings separate the hygrine imperfectly under the best management, but are practically sufficient until some better plan can be devised. But when they separate it most perfectly they also take with it a portion of cocaine, and therefore they are kept for another process of solution and separation when they have accumulated. The solution of sulphate of cocaine, now sufficiently freed from hygrine, is then transferred to a precipitating jar, and the carbonate of sodium solution is slowly added to it, with constant active stirring until a small portion of mother liquid filtered off, gives no cloud on adding a drop of the precipitant. The whole is then well stirred, and allowed to stand overnight. The clear supernatant liquid is then drawn off into one or more bottles, which are about half filled with it, and the precipitate is collected on a filter and well washed with water until the washings come off tasteless. This washing is more effective when the clean washed upper stratum of the precipitate is taken off two or three times as the washing proceeds. The mother-liquor and washings collected in bottles are washed twice, each time with about one-eighth of their volume of stronger ether to recover the alkaloid retained in them. The ether from these washings is recovered by distillation, and the alkaloid, amounting to about ·1 p.c. of the total quantity precipitated, is carried on to the next portion. The washing of the precipitated alkaloid is only carried on until the washings come off tasteless or nearly so. Of course, they might be carried farther, or until they gave no reaction for either sulphuric acid or sodium, but this would involve a practically useless loss of alkaloid, since it is not quite insoluble in water. The washed magma is then spread upon a flat-bottomed drying vessel or tray and dried at a very low temperature, say, not over 50° C=122° F.

In drying, the cake breaks up into white, light porous fragments somewhat resembling heavy magnesia. This is a hydrate and carbonate of the alkaloid cocaine, containing more or less of the inert hygrine, according to the management, and in this condition it is kept for conversion into any salt that may be desired. When the hydrochlorate is to be made from it, a portion is put into a shallow evaporating vessel,—flat-bottomed, if possible,—and is just moistened with water. Strong hydrochloric acid is then added cautiously, in small portions, with constant stirring until the alkaloid is exactly saturated, and this solution is then evaporated at a low

temperature. Managed in this way, the evaporation is reduced to a minimum, and in a proper flat vessel takes but little time and heating. The evaporation is allowed to go on spontaneously until a thick pelicle is formed on the surface. When this is broken up by stirring, the solution is a perfectly transparent, syrupy liquid of a full light yellow color,—not colorless,—of about the consistence of ordinary varnish, which it much resembles. Often, on being disturbed by the stirrer, and always after a little stirring, the whole mass suddenly crystallizes in very small crystals, with the evolution of a gas supposed to be carbonic anhydride, forming an opaque pasty, semi-liquid mass. This is then stirred constantly until it is entirely dry—and it is known to be dry when it can be rubbed up and passed through a sieve No. 40. Of the perfectly dry hydrate of the alkaloid 100 parts yield about 114 parts of the dry hydrochlorate.

The net yield of either alkaloid or salt from any given lot of coca cannot, as yet, be accurately stated, because the several residues cannot well be worked up separately. First, there is the chlorophyl and extractive matter which contains some alkaloid, and is, therefore, not thrown away, but is set aside for farther working. Then the alkaline solutions, after the ether washings, all contain alkaloid, most of which appears to be held there by the dissolved ether. Then there is the very valuable proportion that is washed out with the hygrine, making, altogether, a residuary proportion which, by rough estimate, may amount to 2 p.c., that is recoverable, though at considerable expense for ether, time and labor. The yield of crude, mixed alkaloids, is always easily obtainable, since they are dried in order to get at the proportion of solvents and bone-black needed in the purification. But these crude alkaloids yield very differently to the process of purification, as they contain more or less hygrine and products of decomposition. Occasionally they have not yielded more than one-half the weight of the crude alkaloids, while occasionally the loss seems to be not over 20 p.c. A longer experience, with better coca, is required before any very definite account of net yield can be given ; yet it is very apparent that all the cocas worked give a considerably larger yield than was indicated by the old process of assay, and by the first experience in the extraction.

One lot of 164 pounds or 74,545 grammes yielded 319 grammes, or very nearly ·427 p.c. of crude alkaloids, and about ·34 p.c. of the finished salt. This was a lot of young and very green leaves,

and cost $1.50 per pound. It appeared to be very good coca, though evidently not mature. Gathered when too young, but well cured and well packed.

Another lot of 280 pounds or 127,272 grammes yielded 409 grammes of crude alkaloid or ·321 p.c. and about ·27 p.c. of finished salt. This was a lot of mature leaves, not green, but of very fair quality of the brownish grades, the best that could be selected in the New York market within the past three months. This lot was bought before the rise in prices, and cost 65c. per pound.

These two lots were worked after a little experience with the above given process, and represent the best results attained at this writing, though two or three other lots of green coca gave somewhat similar results.—whilst four smaller portions were entirely lost in reaching the process.

The above given process does not pretend to be a very good one, but only the best that could be reached by the writer in two months or more of close and unremitting application to the subject. Those more familiar with the extraction and purification of the sensitive alkaloids may all have better processes for this one, but if they have, they have not published them. It is, at least, an effective working process, yielding a very good alkaloid in considerably larger proportion than was expected from any coca now accessible, and a larger proportion than is given in any published account of the extraction, and it is expected that with farther experience and improvements in the details, the net yield will be still farther increased, especially when better coca is attainable. But it is an expensive process in solvents, time, labor and apparatus, and, from the value of the product, is especially risky by breakage and accidental losses. The actual loss of alcohol by the process is not short of 20 gallons to the 100 pounds of coca, and of stronger ether about 12.5 pounds, making, in these two items alone, a cost of not less than $54.00 per 100 pounds of coca for these heavily taxed solvents, which in other countries, or in this, without the alcohol tax, would not cost more than one-sixth of that, or $9.00 per 100 pounds of coca.

The coca that has been accessible in any of the markets within the past three months has all been of low quality, and very variable, some of it yielding no alkaloid at all, though not differing in appearance from others that yielded in fair proportion, so that it has not been safe to buy without a previous assay of samples, and hence a good assay process became very important. The writer soon found that the process given at page 604 was not a good one, and

it had to be abandoned. The two lots of coca, the details of which are given above, when assayed by the process alluded to, gave respectively only about ·19 and ·16 p.c., but by a new process now to be given they gave much higher results which were in fair practical accord with those obtained in working on the large scale.

This new process of assay is based upon the process of manufacture, and is as follows:

Take 50 grammes of the sample after being powdered and passed through a sieve of 60 meshes to the linear inch. Moisten the powder with an equal weight of alcohol of 92 p.c., to which has been added one-sixtieth of its weight of sulphuric acid s.g. 1·843. Allow the moistened powder to stand in a covered vessel for 3 or 4 hours and then pack it firmly in a cylindrical percolator. Percolate it with alcohol,—not acidulated,—until 250 c.c. of percolate have been obtained. This percolation is very much facilitated by the use of a Sprengel water-pump such as is used in laboratories for rapid filtration. Without this pump the percolation is slow and will require a day and a night. With the filter pump 3 hours is sufficient. Evaporate the alcoholic solution in a shallow broad capsule at a low temperature until it is reduced to about 10 c.c., and then add to this 25 to 50 c.c. of water, applied in two or three portions, carefully washing out all that is soluble in water from the clots of chlorophyl and resinous extractive matter. Filter the solution into a flask or separating apparatus, add to it an equal volume of stronger ether, shake vigorously, separate the solution, add half its volume of ether, and again separate the solution. Add to this an equal volume of ether, and then solution of carbonate of sodium in excess, and shake vigorously. When now the liquids separate a drop of the solution of carbonate of sodium should produce no cloud in the lower stratum of liquid. Separate the ethereal portion, put it into a tared beaker, wash the watery liquid with half its volume of ether, and add the ether to that in the beaker, and set this in a warm place until the ether is all evaporated off. Then pour upon the residue in the beaker 5 c.c. of water, rinse it round well, without a stirrer, and having poured it off, dry the contents of the beaker, weigh, and subtract the tare. The net weight is the crude alkaloids with much coloring matter. On an average a deduction of 20 to 25 p.c. of this weight will give a close approximation to the cocaine contained in the sample.

Allowing the moistened powder to stand 3 or 4 hours allows the powder better to absorb the menstruum, but it is not an import-

ant step, since the amount of percolate prescribed completely exhausts the coca without the digestion, if the powder be as fine as is directed and the percolation well managed. The washing of the acidulated solution of alkaloids from the alcohol residue is an important step, as the soft, green, resinous clots are liable to retain a portion of the alkaloids. The preliminary washing of the acid solution with ether removes a considerable proportion of coloring matter, which, if left in, would be taken up by the ether with the precipitated alkaloids and vitiate the results, while the ether takes little alkaloids from the acid solution. It doubtless takes some alkaloid in the water which it dissolves, and the use of ether previously saturated with water would avoid this slight loss. The alkaloids precipitated by the carbonate of sodium are at once dissolved by the ether, and a small portion of the mother-liquor is also dissolved, which might be avoided by the use of water-saturated ether. In separating the liquids closely, which has to be done several times, an elongated pear-shaped separatory, with a stop-cock at the small end, and a cork at the large end, is very convenient, and these, when used in pairs, drawing off from one to the other, give very rapid work and accurate results. It is necessary to evaporate off the ether from a beaker, because if a capsule be used the creeping over the edge involves serious loss and the washing out of the extractive from the residue is impracticable. The alkaloids are left in the beaker in small varnish-like drops on the sides, and a varnish-like film at the bottom, but in a half hour or an hour of drying the drops generally become star-shaped crystals, and the film at the bottom also crystallizes, but these crystals when touched are found to be sticky, and no amount of drying that the alkaloid will stand is of any avail to dry them farther.

If there be any haste this assay can be easily made by one person in six or eight hours if the filter pump be used, and in a day and a night if the digestion of the moist powder be made, and the percolation be well managed without the pump.

The rationale of the assay process, as well as the process of manufacture, is very simple, and is based on the following conditions:

The alkaloid cocaine, when free, is very easily split up and destroyed by even a moderate degree of heat, and this destruction is materially aided by the presence of alkalis and other chemicals. It is also easily destroyed by heat, etc., when in its natural combination in the leaf, but less easily than when in the free state.

But when made decidedly acid it is freely soluble in alcohol in the cold, and when in alcoholic solution, in this acid condition it bears the heat necessary to distill off the alcohol with but little if any destruction or damage. The alkaloid is soluble in all proportions in stronger ether, while its sulphate and hydrochlorate are not soluble in ether. It can therefore be completely washed out of its ethereal solution by acidulated water, and can also be easily washed out of its watery solution by precipitation in the presence of ether. The solution of its salts in water can be completely precipitated by carbonate of sodium, without the liberation of carbonic acid, but a considerable proportion of the precipitated hydrate of the alkaloids is held in solution in the mother waters whether these contain either sulphate or chloride of sodium. But this portion of alkaloid can be completely washed out by ether.

The hydrated alkaloid cocaine, from the above process, is in light, white spongy fragments, or in light amorphous powder very much like magnesia. It is not perfectly white, but very nearly so. It is nearly insoluble in water, but very soluble in acids, giving solutions that are not quite colorless. When a very small particle is laid upon the tongue, and the tongue then held against the roof of the mouth, a moderately bitter taste is perceived in a few seconds. In a few seconds more the bitterness gives place to a numbness and insensibility of the surfaces, as though scalded by hot liquid, except that there is no pain. This numbness increases for a few minutes, and then diminishes slowly, and disappears in ten to twenty minutes in proportion to the quantity applied.

The hydrochlorate of cocaine from the above process is an almost white crystalline powder, though the fragments of crystals are so small that it appears to be an amorphous powder, even under a glass of low power. The powder when dry is loose and mobile, but when exposed to damp air becomes a little damp and clammy, although it does not appear to be deliquescent. It is soluble in all proportions in hot water and in alcohol, and in somewhat less than half its weight of water at ordinary temperatures. Its solutions are not colorless, but appear to be nearly so when seen in small vials, even up to the strength of 20 p.c. Solutions of 50 or 60 p.c. strength are, however, even in small vials, of a greenish-yellow tint. The solutions are neutral to test paper. When tested with solution of chloride of barium they give, after a moment or two, the faintest cloud (limit of sulphates). With test-solution of oxalate of ammonium the result is negative (absence of lime). When the salt is

burnt off a platinum surface, there is merely a trace of residue (limit of inorganic matter). And the spot moistened with water scarcely affects the color of neutral litmus paper (limit of inorganic alkalis). A test is very much needed to control the proportion of hygrine and other inert matter admissible, but as yet this has not been found.

The solutions are all liable to deteriorate by the growth of microscopic plants, which are nourished by the alkaloid, and therefore destroy it. These growths commence usually within a week, and when once started they increase rather rapidly. As the salt will always be used in solution, and as many persons will not take the time and trouble for even so small a matter as the making of accurate solutions, it becomes highly important to fix upon a definite standard strength of solution for ordinary uses, and to have this securely protected against change in keeping. There are several agents which prevent these growths in alkaloid solutions, and among the most effective are carbolic acid, salicylic acid, boric acid and the aromatic series. A small proportion of ether often prevents the growths, and as this seemed least objectionable here, it was tried, but failed, until the proportion was so large as to be irritating to mucous membranes. All the protective agents are somewhat irritant even in dilute solution, and in selecting the one which seemed least irritant, and which was effective in the smallest proportion, salicylic acid was adopted. An incidental objection to this acid is its extreme sensitiveness to the presence of very minute traces of iron. Almost all filtering paper contains iron enough to react with salicylic acid, and in handling extracts, alkaloids, etc., it is not easy to avoid the use of steel spatulas, tinned iron funnels, etc. Hence it is, that a very nearly or quite colorless solution of hydrochlorate of cocaine, when mixed with a very dilute solution of salicylic acid, will, either at once or in a few hours, in proportion to the amount of iron present, become very sensibly deeper in tint, and of a reddish brown tint. As no possible harm can come from this tint, and as a tinted solution is just as good as a colorless one, this objection to salicylic acid was not considered of sufficient weight to cause it to be rejected. Boric acid seemed to be a much better protective agent, in that its effects upon mucous membranes, —of the eye, for example, are not at all irritant, but, on the contrary, are sedative. But it is a much less certain protective, and is required in so much larger a proportion than salicylic acid, that it was not thought safe to adopt it.

At ordinary temperatures 1 part of salicylic acid is held in solution by about 300 parts of water, and it is good practice to keep such a solution standing upon some undissolved crystals for use in protecting solutions of the alkaloids for hypodermic and general use. In making up the solutions of alkaloids, a good rule is to take one-half water and the remainder of the solution of salicylic acid, as the solvent. This gives to the solution of the alkaloid salt about one six-hundredth part of salicylic acid,— a proportion that can hardly be objectionable in any way, and yet is sufficient to protect the solutions indefinitely.

In the ordinary uses of hydrochlorate of cocaine, common usage seems to have fixed upon a strength of 4 p.c. as being at the same time sufficiently effective, and economical in regard to waste. It is more irritating on first application than a 2 p.c. solution, and less irritating than stronger solutions, but from greater concentration it is more prompt in effect, is less liable to spread over broad surface and be diluted by secretions, and less liable to waste by overflow, in the increased quantity required. Hence it is more than twice as effective as a 2 p.c. solution, and, therefore, more economical in cost as well as in time and promptitude of action. Beside, when a 2 p.c. solution is preferred, or a 1 p.c. solution is required for therapeutic purposes, these can be easily made from the 4 p.c. by dilution with water. Of course an equal number of drops, from the same dropping tube, of 4 p.c. solution and of water, make a 2 p.c. solution. And 1 drop to 3 of water makes a 1 p.c. solution.

In making a very accurate 4 p.c. solution, of course it should be done by weight. Of the salt 1 part, of water and solution of salicylic acid each, 12 parts. But weighing is not necessary in ordinary practice. It is quite sufficient to dissolve each grain of the salt in 12 minims each of water and solution of salicylic acid, or the contents of each 5 grain vial of the salt in 60 minims each of water and solution of salicylic acid ; or, each 1 gramme vial in 12 c.c. each of water and solution of salicylic acid. That is, the salt makes 25 times its weight of 4 p.c. solution, or 50 times its weight of 2 p.c. solution, and minims and grains are, perhaps, near enough to equality in value for rough usage. At least this is the best that can be done by those who reject the metric system. All solutions of alkaloid salts should be filtered through paper, because it is almost impossible to avoid particles of dust in the salt and solvents.

The 4 p.c. solution, when protected by salicylic acid, gives a faint but very distinctly acid reaction with test paper. It is scarcely

affected by test solution of chloride of barium, but gives a dense precipitate with test-solution of nitrate of silver. An ordinary dropping tube or pipette, such as is used in eye practice, delivers drops of just about half a minim or ·031 c.c. One such drop in $3\frac{1}{3}$ fluidounces, or 100 c.c. of distilled water, gives in a 10 c.c. test-tube a distinct cloud with a single drop of test-solution of iodide of mercury and potassium. The cloud is barely perceptible on very close observation in a dilution of 125 c.c., and this appears to be the limit.

A piece of bibulous paper 6 millimetres or a quarter of an inch square will hold about the twentieth of a drop or the fortieth of a minim. This, when laid upon the tongue, and the tongue then applied against the roof of the mouth, should, in a minute or less, give a strong numbness to both surfaces.

The salt is put up in vials of 5, 10, 15, 20, 30 and 60 grains each, and the 4 p. c. solution in vials of 1, 2, 4 and 8 fluidrachms. The vials of the salt, when properly protected, can go through the mails, but the solution cannot, as liquids are absolutely excluded from the mails by law.

The demand for both the salt and the solution has been so very active, and the production so limited, that the prices have remained very high up to this time, and it is said that the scarcity of good coca, from which to make them, is likely to continue until the new crop is ready in May. Even moderately good coca is now held at 80c. to $1.25, while for some $1.50 is demanded, and it is about as scarce and high, and the quality about as poor in Europe as it is here, but that this condition can be maintained until May the writer doubts, since high prices for an article which is produced in such abundance, commonly brings it from unexpected and unusual sources. Merck, of Darmstadt, has until very lately been the principal maker. He has advanced his price three or four times, and has supplied a very small proportion of what has been ordered from him, and he now announces that he can get but a limited supply of coca, and will be able to supply even less than before. At least five manufacturers in this country announce that they are making it in considerable quantities and are supplying all their orders. The price here and in England is about 50 c. per grain for the hydrochlorate of cocaine, and $10 per fluidounce for the 4 p.c. solution. But there has been a preference for Merck's salt, which, with its scarcity, makes it bring now about 85c. per grain. As long as the demand remains so active, and coca so scarce and high,

these prices may possibly be maintained, since if one manufacturer gets ahead of the others either in supply of coca or in his process of manufacture, he will still maintain his price as long as he can market his product at it. But with a fair supply of coca, at even full prices, there is no reason for any such prices. Any one who puts his prices down now will simply have his stock rapidly exhausted and be unable to supply his orders, but there is really no other reason why the salt should not be sold at less than half the present prices. With a supply of good coca accessible, this writer would be glad to make it at 15 or 18c. per grain, even with the high cost of solvents, by the above given process, and it is to be hoped that such a supply of coca is not many months off. The cost of extracting and purifying the alkaloid at present is perhaps not over $1.20 per pound of coca leaves, and if the leaves cost, say 80c., the total would be about $2.00 per pound. Then if the yield of alkaloid be, ·27 p.c. or 19 grains to the pound, equal to about 21 grains of the hydrochlorate, the net cost would be about 10 cents a grain, and 15 cents would then be a fair selling price, considering the character and quality of the work on it. This estimate, however, does not take into account the time, skill and expenditure of material in getting a good working process, which, in this instance, to the writer, has been several hundred dollars; nor does it take in the probability that farther experience may lessen the cost of production. A much more moderate demand for the salt is also to be expected as the excitement about it diminishes, and the absurd misuses to which it is applied are abandoned, and this will aid very much in moderating the prices. And, for the best interest of the agent, it is by no means desirable that they should be maintained.

A new agent of such importance is very rarely so suddenly found, and it is not wonderful that it should produce much excitement, and be much abused, through the temporary enthusiasm in regard to its application, but it is to be hoped that this excitement will not last much longer, and that some of the failures and demerits, if there be any, will be heard of. It is certainly being very widely used, in very considerable quantities, all over this country, for all sorts of purposes, rational and irrational, and a most important experience with it must be rapidly accumulating. In illustration of how recklessly and empirically it has been applied, statements are published of its internal use in typhoid fever, diphtheria, scarlatina, and other diseases, and with alleged success, notwithstanding that all this ground of therapeutic uses internally, has been

gone over long ago with negative results. Locally for anæsthetic purposes it has been applied to the skin for the excision of tumors, and by hypodermic injection around parts to be incised, and generally with a published success that it is impossible to comprehend, except as results of enthusiasm. Many such published successful applications repeated in other hands have failed entirely, or almost entirely, whilst others,—and these the more rational—have often failed of the complete success claimed for them.

There have been a very large number of papers in the journals upon its applications and their advantages, and many conservative writers have given their testimony and experience in regard to its importance, without enthusiasm. Such papers are becoming more common of late, and they are doing much to abate the excitement and lessen the demand.

Since the writer's last note on this subject the original paper of Dr. Carl Koller, of Vienna, the discoverer of the anæsthetic effects of cocaine salts, has been published. It is a very important paper, and a translation of it may be found in the London *Lancet* for December 6, 1884, page 990. The paper was read at the meeting of the Vienna Royal Imperial Society of Physicians on October 17th, 1884. Its English title is "On the Use of Cocaine for Producing Anæsthesia on the Eye." "Translated and Revised by J. N. Bloom, B. A., M. D." This paper sets at rest several important points which should be noted. Dr. Koller says his first announcement of his discovery was to the Convention of German Occulists which met at Heidelberg on the 15th and 16th of September.

He says it is a well known fact since 1862, when it was announced by Prof. Schroff, that cocaine anæsthetized the mucous membrane of the tongue. And that it was also known that, when taken internally, it narrows the peripheral arteries, and farther, that the pupil was dilated both by its local application and its internal use. Dr. von Anrep in 1880, published researches upon cocaine, at the end of which it was hinted that the local anæsthetic action of cocaine might in the future become of considerable importance. But it was not until his, Dr. Koller's, investigations and experiments, first on animals and then on man, that its practical applicability to general use as a local anæsthetic was known, and of this he was the discoverer, and he was led to the discovery by the known effects upon the tongue. He states that in his experiments he used the "muriate of cocaine" in aqueous solution, and that when a few drops of this was put into an animal's eye the first effect was that of a weak irritant. To this statement he has a footnote to the effect that "A solution of cocaine in water, up to 5

p.c., can be made without the addition of an acid. The solution is always cloudy. The addition of an acid is to be avoided, as even a very small quantity of an acid causes a very strong burning sensation. When filtered the solution becomes as clear as distilled water." This note was either too loosely written or badly translated. The alkaloid cocaine is scarcely at all soluble in water. Authorities say 1 part in 704 of water, and this is probably correct. The author meant to say that the "muriate of cocaine," as he calls it in the text of his paper, meaning the hydrochlorate, was soluble to the strength of 5 p.c., but always gave a cloudy solution which was cleared by the addition of an acid, but that the addition of an acid was objectionable. In this statement he is in error, as any well made muriate, or hydrochlorate of cocaine, is perfectly soluble in less than its weight of water, and makes a clear solution which is neutral, and not acid.

From experiments on animals he found that the anæsthesia was very superficial, and only complete for the cornea and conjunctiva. From these he proceeded to experiments upon himself and a few colleagues, and finally, upon patients. The sequence of the symptoms he gives as follows: "When a few drops of a two per cent. solution are introduced into the conjunctival sac, or, better still, if they are allowed to run over the cornea,—together with an increased secretion of tears, a slight burning sensation is felt, which disappears after an interval of from thirty seconds to a minute, to give way to an obscure feeling of dryness. To the observer an eye thus treated has a peculiar rigid expression, very like that which I noticed as remarkable on the animals upon which I experimented. This expression arises from a decided widening of the palpebral fissure, the explanation of which I shall give later. If now the head of a pin is brought in contact with the cornea we note the absence not only of the pain usually associated, but we absolutely do not feel the contact, and all reflexes are absent. The same holds good for the conjunctiva, which loses its sensibility to heat and cold. Without any inconvenient sensation, or the slightest reflex movement on the part of the patient thus treated, we can grasp the conjunctiva of the bulb with a toothed forceps, or we can pit the cornea by pressure. In this connection the only thing to be observed is that the appearance of objects becomes indistinct, which naturally is caused by the changed curvature of the cornea. This complete anæsthesia lasts from seven to ten minutes, to give way to the normal condition after a considerable period of subnormal sensibility." He then goes on to describe the mydriatic effects, and, finally, to its therapeutic and surgical application.

uses and effects. He finds that its use in diseases of the eye has no influence, beneficial or otherwise, on the course of disease, but simply relieves the pain temporarily, or during the repetition of the application; but the pain, intolerance of light, etc., seem to have been lessened, not abolished.

The agent, however, was too dear for continued trials in these cases, and all the trials seem to have been made with a 2 p.c. solution, and that solution made from a salt which does not seem to have been very good, although he suspected no deficiency in quality.

In the surgical applications, however, he used a 5 p.c. solution, and commencing half an hour before the operation, instilled two drops every five minutes, the patient lying on his back without a pillow; and even by this method the deeper tissues of the eye were not insensible, though the iris was cut without pain.

In reviewing these statements of Dr. Koller, it will be observed that they are moderate in tone and character, and not enthusiastic, and that they have been in the main fully confirmed by many observers.

It has been said that the smarting or burning from the first instillation was more severe and more prolonged than it should be from his history; but it must be remembered that so bitter and powerful a salt could not but be primarily irritant, and that a 4 p.c. solution, as now commonly used, must be twice as irritating as one of 2 p.c. It seems rational and probable that a single drop of 4 p.c. solution at first, would reduce this smarting to a minimum, and admit of the larger dose of two drops to be used in the dryer stage, when it would be less diluted by tears and when less of it would be washed away.

From the accounts of operators here, it would seem that two drops of a 5 p.c. solution every five minutes, for half an hour, is wasteful, both of the agent and of time, unless the agent was defective in quality. Five drops of a 4 p.c. solution in two instillations, ten minutes apart, seems to be a sufficient quantity, and fifteen to twenty minutes a sufficient time. Some operators give the history of a much more copious use of the solution, and this suggests the probability of great waste. The greater or less lachrymation in different cases has doubtless an important bearing both upon the quantity required and the time, by the greater or less dilution and washing away of the agent.

In applying the solution to other mucous membranes than those of the eye, a camel's hair pencil has generally been used, but under the very best management, and upon surfaces made as dry as possible, the pencil leaves but a very small quantity upon the surface, and it is not to be expected that complete anæsthesia is easily

attainable in this way, however frequent the applications, and a profuse use of the agent does no good, since it immediately runs off the surface. Neither is it of any use to apply it to surfaces coated with secretions, no matter how thin the coating, if they are of the glairy kind, since efficient contact with the surfaces is then impossible, and the waste is as complete as an application to the skin covered by epidermis. So, on its application to painful ulcers, burns, etc., care must always be taken to obtain contact of the solution by having the surfaces perfectly clean. A blistered surface, if covered with the natural exudation, is almost or quite beyond the reach of the solution in proportion as the exudation is thin enough in consistence to mix with the solution when applied. The model condition for effective use is the mucous membrane of the eye, and upon any surface in that clean condition it will be as certainly effective. In applying it to denuded surfaces and to mucous membranes which will admit it, the best method is to have some light covering of the desired shape and size, that will hold the solution. A thin filtering paper will be moistened over an area of fully a square inch by a single drop, or half a minim of the solution, and under favorable circumstances that will superficially benumb an equal area of mucous membrane. Any one can convince himself of this fact by placing such a piece of paper on his tongue, if the organ be rinsed off clean before the paper is laid on. Such a paper when touched occasionally with a camel's hair pencil charged with solution will have its efficiency strengthened, and upon the tongue, for example, any effect possible to the agent is obtainable in that way. But paper is not a convenient tissue for such application. Fine thin cotton or linen fabric is much better, and nothing can be better than well-worn fine handkerchief material. This is sufficiently absorbent to hold the dose, and thin enough to avoid waste and to be closely applicable to irregular surfaces. When touched in situ, for resupply, the brush should be applied to the upper edge of the tissue, so as to run down through it before draining off, and the smallest possible quantity should be applied at a time if waste by running off be avoided. Much solution is wasted by the use of camel's-hair pencils many sizes too large. Indeed, it is hardly possible to get a brush too small to convey this solution economically, unless large surfaces are to be coated. In the use of a brush for applying the solution it should never be dipped into the vial of solution, because it carries back secretions and excretions which rapidly spoil the remaining solution, and it is thus wasted. The proper way is to drop out the quantity to be used on the bottom of a tumbler or wine glass, and dip the brush in

this until it is all used, never putting any back into the vial. In this way any desired quantity may be used and none be spoiled or wasted. If any one will try the effect of a single drop of 4 p.c. solution put directly upon his tongue without rinsing, and then, half an hour later, rinse the tongue clean and apply the same quantity upon a piece of thin bibulous paper half an inch in diameter, he will be convinced that many failures are due to faulty application, and may see that one drop well applied may be as effective as the nature of the agent will admit of, and quite as effective as ten drops badly applied. From reading the published accounts of the application of the solution, it seems highly probable that more of it is wasted than is really utilized, and if this waste could be stopped without increasing the number of failures, the price of the chemical would soon come down.

Little has been written upon the mode of action of cocaine salts as local anæsthetics; or rather, the writer has seen no attempt to explain how coca in substance should be a nervous stimulant, and yet its alkaloid be a most powerful nervous sedative. The two effects cannot possibly be antagonistic, for that is irrational, neither can the effects be due to quantity. Some other rational explanation will doubtless be reached, and the writer offers the hypothesis that the local effect may be measurably a mechanical one, and thus be independent of the effects when it is taken internally. Any agent that would contract the supply vessels of the terminal bulbs of the sensitive nerves, and press out the blood from them, would to the same extent lessen the sensibility of the part, and if the capillaries were emptied entirely by such contraction, sensation would be abolished as completely as the galvanic current is abolished when the liquid is drawn off from the plates. The application of cold abolishes sensation in this way, and is a local anæsthetic of the same character as cocaine salts, and the benumbing is of the same kind in its observable degrees. Heat also has a similar action when just short of that degree which coagulates the albumen of the bulbs and the circulating fluids. Carbolic acid is also a very effective local anæsthetic by something of the same kind of action, of contracting the capillary vessels, and thus diminishing the supply of the excitant fluid necessary to the function of sensation. But all these agents, when their action is carried to the degree of complete anæsthesia, are proportionately destructive of tissue, and either kill the parts or cause destructive inflammation. All cause blanching of the tissues by pressing out the coloring liquid,—namely, the red blood; and tissues when thoroughly benumbed by cold or heat or carbolic acid, are found comparatively

bloodless when incised. An injury to a very cold hand or foot is not painful, neither does it bleed much, but, as it is warmed, the bleeding and pain come on together. It has been noticed by several observers that red mucous membranes, when anæsthetized by salts of cocaine, are white, and when cut into very superficially,—that is when the cut is not deeper than the anæsthesia,—there is but little bleeding. This, if true, is precisely the condition in anæsthesia by cold, and the condition in both cases may be due to the same cause, namely, contraction of capillaries whereby the circulation is diminished or practically suspended. Then, if the effect of cold in producing anæsthesia be a mechanical effect, the similar effect of cocaine, if produced in a similar way, is probably also mechanical. This, in a profound sense, is of course no explanation at all, since it does not touch the reason why cocaine should, or does contract the capillary vessels, and thus deprive the function of sensation of its exciting cause and necessary condition, but yet such explanation goes far enough to show how the same agent may rationally be a nervous stimulant when given internally, and yet be a powerful nervous sedative when locally applied. Indeed the explanation given of the mode of action is supported by the observations of the early investigators of the physiological effects when internally administered, since they showed that one prominent effect was to contract the peripheral arteries.

If the explanation be true, there is no difficulty in comprehending why the local anæsthesia is a condition of degrees, and can hardly be complete in tissues supplied with vessels of considerable size, and that the anæsthesia of tissues below the surface must depend for degrees upon the rate and amount of absorption of the agent, since it cannot be conveyed from the surface to the deeper parts by vessels which are closed or contracted by it so as to abolish or reduce their carrying capacity.

The explanation also serves to show why it is without effect when applied to the skin, since the epidermis there prevents mechanical contact with the capillaries. But if the skin was well soaked with water so as to soften the epidermis and bring it into a condition similar to that of the epithelium, then the agent should at least have some effect. Or, in combination with, or solution in some such liquid as oleic acid which can get through the epidermis, or be absorbed, it should be somewhat effective.

The position taken by the writer of having abandoned coca as a therapeutic agent on account of the poor quality of the drug as accessible in the markets, has been publicly criticised when it was found

that that same coca, thus condemned, really yields a large proportion of cocaine, and has been the source from which most of the alkaloid has been obtained.

This is apparently a fair criticism, and the position perhaps requires a word of defense. Coca as a therapeutic agent is a nervous stimulant, yielding effects identical with those of tea and coffee, while the effects of the alkaloid cocaine are those of a local anæsthetic,—the two effects being as dissimilar as are those of tea from those of benumbing cold. The nervous stimulation derived from tea and coffee appear to be something distinct from, or something superadded to, the effects of their common principle caffeine. That is, the commonest Congo teas which sell at 20 to 25 cents per pound, contain over 70 p.c. of the amount of caffeine which the very best teas costing 80 to 85 cents contain, yet of course they are very far from being as good teas when applied to the usual purpose of nervous stimulation. The Congo teas would be, of course, far the cheapest, and therefore the best material for making caffeine from, and as a matter of fact they are so used, but they are not used when good teas or fine teas are wanted or appreciated, as nervous stimulants and restoratives.

Exactly the same conditions obtain in regard to coca. The nervous stimulant effect is something that appears to be superadded to the cocaine present, and the analogy with tea makes it easy to comprehend why good fresh coca may not contain more than 20 to 30 p.c. of cocaine more than the poor, stale, brown leaves do, and yet be 50 to 70 p.c. better as a nervous stimulant for therapeutic uses.

It is quite true that while some lots of the brown leaves contain scarcely any cocaine at all, others, not very dissimilar in appearance and physical properties, yield perhaps 80 or even 90 p.c. of what the best fresh green leaves do, thus rendering an assay necessary to discriminate between them,—it is also equally true, as far as the writer's experience goes, that the brown leaves never yield as much cocaine as the fresh green leaves do, though cheaper and therefore better as a source from which to extract the alkaloid, and are probably never as good,—even in proportion to the alkaloid contained in them, as the fresh green leaves are, for therapeutic use. Therefore, the fresh green leaves, only, should be used for making the fluid extract, and should be used without heat, and when they cannot be had, the fluid extract should be abandoned, leaving the brown leaves, as proper only for the manufacture of cocaine. And if nothing but low grade Congo teas could be had in the market the fluid extract should not be made from them, but should be abandoned, although these teas contain a very large proportion of caffeine.

SULPHATE OF QUININE.

There are one or two points in the recent history of this important chemical which are of especial interest.

Few articles show the important influence upon the market of a few moderately simple and easy tests of quality. There is not known to be a single nameless make at present in the ordinary market. All that is publicly offered at least has the maker's name on it, or is sold as from some known maker, and every make is of fairly good quality. The quantity of lower cinchona alkaloids is small and practically pretty uniform. The amount of moisture is also small and fairly uniform, showing that careless manipulation is rare, and adulteration unknown at least in the general markets for buyers who seek only for fair quality. Some makers are preferred over others, and get rather better prices, probably because their brands have longer maintained a uniform standard of quality, but all the prominent makers are now in fair, practical uniformity. One very old maker of a salt of excellent quality and uniformity is, however, an exception, because his product is rather unpopular from having a faint pinkish tint, few stopping to remember that the value given by the prized dazzling whiteness is a fictitious one.

Coincident with this excellence and uniformity of quality, the price has been unprecedentedly low. There have been great variations of price without any corresponding variation in consumption, and this always suggests speculation,—that great bane of the markets. For two months past about the highest prices in large quantities for specially preferred brands has been $1.05 per ounce, while at one time the common brands sold for a day or two as low as 78 cents, affording special opportunity for speculators to "load up" just as they do in Wall street. This was followed by a sharp demand and a sharp advance, and the price was soon again up to 97½ cts. to $1.05. Some time before these low prices were reached, the largest manufactory in the world failed disastrously and was closed, and one of the largest dealers in cinchona barks also failed. These disasters led to the expectation of higher prices on the principle of more room left for the others. But, on the contrary, prices steadily declined to the present figures,—and what looks very wonderful to outsiders,—the price of barks generally ruling higher than the chemicals, and everybody claiming to be losing money rapidly. Still all keep on making, and one maker at least begins to enlarge his capacity of production.

With all the wonderful success of cinchona cultivation in India, and with the opening of new sources of it in South America, as in

the case of the Cuprea barks, there seems to be every probability of great abundance of material for the future, and this is probably the chief cause of the low prices. New processes of manufacture have been started of late, and larger yields have been obtained from the barks, yet with all this it seems hardly probable that the net cost of making sulphate of quinine can be less than 75 cts. per ounce, at the present time, to those who make it to the best advantage. This is a mere inference, since nobody is permitted to know what goes on inside these manufactories, but if it be true, or nearly so, and the competition be as free as it now is, there is no danger of higher prices for the cinchona alkaloids in the future, and that is the point which is most interesting to small dealers and consumers.

IODINE.

This is another important chemical which of late has been subjected to what, in the language of the markets, is called a sharp movement, leading to an active or excited market, which is the El Dorado of the speculator in drugs and chemicals, as well as of the speculator in stocks and bonds.

Iodine comes mainly from two sources. The first and oldest source is from kelp collected on the shores of Scotland, but a later and very prolific source is from the mother-liquors of the manufacture of nitrate of sodium in Chili. The product of both sources is in some way combined and manipulated in the London market, and very few holders of iodine know when they are safe from this manipulation. In the early days of iodine it was produced in very small quantities, and appeared in the London market from Scotland in ounces (avoirdupois) and was quoted in ounces. And, although now handled by the thousands of pounds, it is still quoted by the ounce, and the range of price quotations is all the way from 4 pence to 12 pence per ounce, or from about $1.25 to $3.75 per pound. By inference the cost to manufacture it from kelp may be about $1.00 per pound, or a little less, or, from the Chilian source, much less than this. Within the past two months or thereabouts the price fell off to about $1.25 per pound, but then it took a turn without any known reason, other than the stories of the market, and went rapidly up to about $3.25 per pound, and notice was given that on January 1st, it would be advanced to 11 pence per ounce, or say $3.50 per pound. This last advance is not as yet realized here, and it is hoped that the London market has reached its breaking strain for the present excitement at least, for fortunately, these excitements cannot be kept up indefinitely, no more than in

stocks and bonds. Of course such mutations in the price of iodine carry with them similar changes in prices of iodides and all other combinations of iodine, and are fruitful sources of profit to some, and corresponding loss to others among the bull and bear middlemen, the punishment falling sometimes upon the one and sometimes upon the other. But the class which never gains but always loses is the lamb-class—namely, the consumers.

THE PHARMACOPŒIA OF 1880.

(Review continued.)

AQUA.

WATER.

H_2O ; 18.—*HO ;* 9.

Natural Water in its purest attainable state.

A colorless, limpid liquid, without odor and taste at ordinary temperatures, and remaining odorless while being heated to boiling, of a perfectly neutral reaction, and containing not more than 1 part of fixed impurities in 10,000 parts.

The transparency or color of Water should not be affected by hydrosulphuric acid or sulphide of ammonium (abs. of metallic impurities). On heating 100 c.c. of Water, acidulated with 10 c.c. of diluted sulphuric acid, to boiling, and adding enough of a dilute solution of permanganate of potassium (1 in 1,000) to impart to the liquid a decided rose-red tint, this tint should not be entirely destroyed by boiling for five minutes (abs. of more than traces of organic or other oxidizable matters).

Preparation : Aqua Destillata.

The requirement that natural water for pharmacopœial uses should stand the permanganate of potassium test in its rigorous application, as given here, is hardly practicable, because very few such waters will stand that test, and to exclude all that will not, would very much obstruct pharmacy. It would have been quite sufficient, and more practical, to have directed that a faint rosy tint of the water should not disappear within ten or fifteen minutes in the cold.

But this important test, as given here and under the head of "Distilled Water," will be very disappointing and misleading if other conditions than those given are not carefully attended to.

In the first place, the quantity of the test-solution used is quite as important as the quantities of water and acid, because if the tint is deep, a change that would leave a fainter tint, colorless, cannot be seen, and a decided rose-red tint is too indefinite. The proper quantity to add is half a cubic centimetre, which gives a pale rose tint, yet quite decided enough, and this amount of color, without the boiling, will be discharged in fifteen or twenty minutes in many

natural waters of good quality. But the condition which most frequently vitiates the testing, is the use of vessels, measures, etc., which are not chemically clean. The amount of oxidizable matter sufficient to decolorize, even a solution of twice the depth of color indicated by the test, is extremely small, and a beaker which appears to be clean, so far as inspection will discover, may yet decompose the permanganate, and, in fact, often does so, thus condemning the water upon defective testing. If the beaker appears to be clean, and the water does not stand the test, the testing should always be repeated in the same beaker, when it may be found to stand the test very well, because the first permanganate solution has cleaned the beaker. As a rule, no vessel should be used for this testing without having been first made chemically clean by permanganate solution, or by concentrated sulphuric acid ; and the sulphuric acid used to acidulate the water should be colorless. It is generally difficult to boil water in a chemically clean vessel. Even with a platinum stirrer resting on the bottom of the vessel the boiling is generally explosive and irregular ; and in cases like this there appears to be no remedy short of continuous stirring as the water approaches the boiling point.

With the modified application of this test, in the cold, to natural water, and the more rigorous application, as given, for Distilled Water, the testing would be more practically useful, as the other tests prescribed are very full and sufficient.

AQUA AMMONIÆ.

WATER OF AMMONIA.

An aqueous solution of Ammonia [NH_3 ; 17.—NH_3 ; 17], containing 10 per cent., by weight, of the gas.

Water of Ammonia should be kept in glass-stoppered bottles, in a cool place.

A colorless, transparent liquid, of a very pungent odor, an acrid, alkaline taste, and a strongly alkaline reaction. Sp. gr. 0.959 at 15° C. (59° F.). It is completely volatilized by the heat of a water-bath. On bringing a glass rod dipped into hydrochloric acid near the liquid, dense, white fumes are evolved.

On supersaturating Water of Ammonia with diluted sulphuric acid, no empyreumatic odor should be developed. Water of Ammonia should remain clear or be at most only faintly clouded when mixed with 5 times its volume of lime-water (only minute traces of carbonic acid). When supersatured with nitric acid, the liquid should remain clear on the addition of test-solution of chloride of barium (sulphate), or of nitrate of silver (chloride). Either before or after neutralization with nitric acid, it should not be affected by hydrosulphuric acid (metallic impurities). Test-solution of oxalate of ammonium should produce no cloudiness (calcium).

To neutralize 8.5 Gm. (or 8.9 C.c.) of Water of Ammonia should require 50 C.c. of the volumetric solution of oxalic acid.

Preparations: Linimentum Ammoniæ. Spiritus Ammoniæ Aromaticus.

This important article as found in the ordinary market, although quite good enough for common use in the arts and even for many pharmaceutical purposes, is often very unfit for medicinal uses, and for some pharmaceutical uses, by reason of the empyreumatic substances contained in it. It is very commonly made from gas liquors and then can scarcely ever be quite clean. For most uses of the Pharmacopœia it should be made from the chloride, the gas being well washed with milk of lime, and be then partly dried by passing through a well cooled condenser. This latter step in taking out the condensable water, takes with it the remaining traces of uncleanness, and the gas then passed into distilled water yields a solution of it which is nearly chemically pure. This is the product aimed at by the above description and tests, and they are full, accurate and discriminating.

A very good officinal specimen examined for the purposes of this note, had a specific gravity as follows :

At 4° C.=39.2° F.	compared with	water at	4°C.	·96170.
15° C.=59° F.	"	"	" 15°C.	·95956.
15.6° C.=60° F.	"	"	" 15.6°C.	·95940.
25° C.=77° F.	"	"	" 15.6°C.	·95652.
25° C.=77° F.	"	"	" 15°C.	·95642.

In applying the test of neutralizing with volumetric solution of oxalic acid, the water of ammonia should be measured,—not weighed.—as in the weighing so much strength is lost that a strictly officinal ammonia will not stand the test. The volumetric solution should be run into the beaker first to the amount of say 35 to 40 c.c., and the 8.9 c.c. of the ammonia should be run directly into this with the least practicable exposure, and then the remainder of the volumetric solution should be added carefully from the burette until the point of saturation is reached. In this way very little of the ammonia escapes.

The 8.9 c.c. of the water of ammonia, the s.g. of which is above given, required 50.4 c.c. of the volumetric solution of oxalic acid for saturation. It was, therefore, very slightly stronger than is required by the test, but was quite as near as is easily practicable. Instead of containing exactly 10 p.c. it contained 10.06 p.c.

In judging of the amount of empyreuma present, in a saturated ammonia, the sense of smell, unless very acute or well trained, is hardly trustworthy, and a more accurate and critical test is by the test-solution of permanganate of potassium. If three drops of this test-solution be added to 10 c.c. of the water of ammonia, the color should not fade out within ten minutes, and the amount and rate of fading is easily seen when compared with a test tube beside it.

containing an equal amount of distilled water and permanganate. This test is more sensitive when applied directly to the water of ammonia than when applied to that which has been supersaturated. but as it detects other organic matters beside those which are empyreumatic, it will also indicate the use of impure water if used for receiving and holding the gas, instead of distilled water.

It seems impracticable, if not impossible, to get water of ammonia that will stand the lime water test perfectly. Even when freshly made from the chloride, and the gas just washed with milk of lime and with very little exposure to any source of carbonic anhydride, the solution of the gas will give a slight opalescence with lime water. In view of these circumstances, it seems probable that the opalescence may be due,—not to carbonate of lime, but to the hydrate, this being less soluble in water of ammonia than in water.

The sulphates and chlorides occasionally found in small proportion in water of ammonia usually come from using water which contains them instead of distilled water, to hold the gas.

Almost all the water of ammonia used in pharmacy and medicine comes from the common market, because few pharmacists will pay the price for a clean article of well-adjusted strength, even in so cheap a chemical as this, and hence it becomes important to know what the common market gives. Any one who examines the water of ammonia of the market, is first struck with the great variation in strength sold under the same trade names, every maker seeming to be a law unto himself; and in regard to this strength it is universally above that required by the U.S.P., and generally very much above it, so that when used for pharmaceutical purposes this must give rise to some very bad pharmacy.

In commerce the strength is still often indicated by the number of F.'s marked upon the containers. "F.F.F." and "F.F.F.F." are the common brands for strength, and as they really mean nothing, any maker can put as many "F.'s" on as he pleases, and in point of fact the three F.'s of some makers is stronger than the four F.'s of others. This fact, becoming rather too widely known, has led to the practice now not uncommon of marking the containers with the degrees of a scale, the scale, however, not being stated.

Then there is "Aqua Ammonia" of "16°," "18°," "20°" and "26°," and if the question be put to the maker, he says the scale is Baumé. According to tables which are in very common use 16° Baumé is equivalent to specific gravity ·960, or ·9591, or ·9589 (Wood and Bache, 15th edition, page 1815), no temperature or standard volume being given. Other tables, in less common use, so increase the range of discrepancy that the mark "16°" is not

very definite, though a great improvement on the number of F's. The specific gravity is the true indication of strength, and this, or better still, the percentage, should always be marked on the packages, but when this is done in the market there is no good way of evading or getting round it, and it is therefore not popular. The indefinite seems always popular with the seller, and of course will remain so until buyers become more definite in their demands.

According to the high authority of Wurtz Dictionary of Chemistry, Vol. I., p. 362, article Aréomètres, 16° Baumé is equal to s.g. ·962 ; 18° to ·948 ; 20° to ·936 ; and 26° to ·899, the weighing temperature given being 15° C., but the standard volume has to be inferred to be the maximum density of water, or 4° C. The last two issues of the French Pharmacopœia give only the table for liquids heavier than water. In this country the equivalent scales, as calculated by Mr. Henry Pemberton, of Philadelphia, published in The American Journal of Pharmacy for January, 1852, p. 1, are perhaps most generally accepted, though they are not always accurately quoted from his original paper. According to Pemberton 16° Baumé is equal to s.g. ·9589 ; 18° to ·9459 ; 20° to ·9333 ; and 26° to ·8980, the weighing temperature given being 60° F., but the standard volume has to be inferred to be that common at the time,—namely, 60° F. By the table of Carius, which is the one commonly used in this country for the equivalency between s.g. and strength of water of ammonia, the specific gravities are given as determined at 14° C., and as Carius is an authority of Continental Europe, it is to be inferred that his standard volume was water at its maximum density. As both his weighing temperature and standard are low, and thus tend to counterbalance each other, his results seem to have been generally accepted as practically correct for a higher weighing temperature and a larger standard volume. As quoted from Watts' Dictionary of Chemistry, article Ammonia, Vol. I., p. 186, his s.g. ·9593 is equal to 10 p.c., which is slightly above 16° Baumé ; s.g. ·9459 is equal to 13.7 p.c. as the equivalent of 18° Baumé ; s.g. ·9333 is equal to 17.4 p.c. as the equivalent of 20° Baumé ; and s.g. ·8980 is equal to 29.84 p.c. as the equivalent of 26° Baumé.

Therefore the Aqua Ammonia of the market which is marked "F.F.F." or "16°," should have a s.g. of ·9593, and contain 10 p.c. of ammoniacal gas. That marked "F.F.F.F." or "18°," should have a s.g. of ·9459, and contain 13.7 p.c. of the gas. That marked "20°" should have a s.g. of ·9333, and contain 17.4 p.c. of the gas. And that marked "26°" should have a s. g. of ·8980, and contain 29.84 p.c. of the gas.

That of 16° is what is commonly sold to druggists who supply

the pharmacists, because it is practically of the pharmacopœial strength ; but for the far larger consumption in the arts, the higher strengths are almost universally sold, and the tendency of the market is toward the higher of these, because of their economy in containing vessels and in freight on the water of dilution ; and because so small a volume is required in processes of saturation.

A sample of very good Aqua Ammonia from the market, marked "19½°" had the following specific gravity :

At	4° C.=39.2° F.	compared with	water at	4° C.	·94406.
"	15° C.=59° F.	"	"	" 15° C.	·94086.
"	15.6°C.=60° F.	"	"	" 15.6° C.	·94072.
"	25° C.=77° F.	"	"	" 15.6° C.	·93702.
"	25° C.=77° F.	"	"	" 15° C.	·93692.

It therefore contained about 15.15 p.c. of the gas.

This water of ammonia stood all the Pharmacopœia tests, excepting a slight empyreumatic odor when saturated, which odor would escape most persons when a small quantity only was saturated. But it did not stand the permanganate test for more than half a minute, the fading of the color being very rapid. It was, however, quite good enough for many pharmaceutical uses, including the making of liniments, but not good enough for many other pharmacopœial uses.

AQUA AMMONIÆ FORTIOR.

STRONGER WATER OF AMMONIA.

An aqueous solution of Ammonia [NH_3 ; 17.—*NH_3 ; 17*], containing 28 per cent., by weight, of the gas.

Stronger Water of Ammonia should be kept in strong glass-stoppered bottles, not completely filled, in a cool place.

A colorless, transparent liquid, of an excessively pungent odor, a very acrid and alkaline taste and a strongly alkaline reaction. Sp. gr. 0.900 at 15° C. (59° F.).

Its reactions of identity and purity are the same as those of *Aqua Ammoniæ*.

To neutralize 3.4 Gm. (or 3.9 c.c.) of Stronger Water of Ammonia should require 56 c.c. of the volumetric solution of oxalic acid.

Preparation : Spiritus Ammoniæ.

A very good specimen of this preparation was found to have the following specific gravity :

At	4° C.=39.2° F.	compared with	water at	4° C.	·90954.
"	15° C.=59° F.	"	"	" 15° C.	·90414.
"	15.6° C.=60° F.	"	"	" 15.6° C.	·90386.
"	25° C.=77° F.	"	"	" 15.6° C.	·89854.
"	25° C.=77° F.	"	"	" 15° C.	·89844.

By the table of Carius, this is equivalent to a strength of 27.4 p.c., while the Pharmacopœia s.g. of ·900 is equivalent to 29.16 p.c.,

although 28 p.c. is given as the officinal equivalent,—·9026 being the equivalent given by Carius for 28 p.c. of the gas.

The neutralization test of the Pharmacopœia carefully applied to this specimen gave 55.6 c.c. of volumetric solution of oxalic acid required to neutralize the prescribed 3.9 c.c. instead of the 56 c.c. of the test. But however carefully this stronger water of ammonia be managed there will always be some loss of the gas in this testing, and therefore it may be that this specimen was up to the strength required by the neutralization test, while it was considerably above it in s.g., showing an error somewhere.

The Pharmacopœia s.g. probably needs correction to the figures ·903, in order to accord with the table of Carius, and with its own neutralization test. In applying this neutralization test 50 c.c. of the volumetric solution of oxalic acid should be run into a vial, and the 3.9 c.c. of the ammonia, very carefully measured, should be run into this, the point of the pipette being held well within the vial in delivering the ammonia. The saturation is then completed from the burette, shaking between the successive small additions. In supersaturating this stronger water of ammonia with sulphuric and nitric acids for testing purposes, it is necessary to dilute it first, to avoid explosive re-action which might damage the eyes.

Unless it be well stoppered this preparation loses strength pretty rapidly, and when well stoppered the stopper is often difficult to loosen. It should never be forgotten that warming the neck of the bottle in order to loosen the stopper is a dangerous practice here, because many severe accidents to the eyes have occurred from careless or thoughtless handling of this liquid. A very little warmth to the bottle gets up a pressure of the gas inside which is liable to scatter the liquid dangerously.

The pain of bites and stings of spiders, bees, wasps and all other insects whose poisons are of an acid nature, is much relieved by the application of ammonia to the part, provided it be promptly applied under some impervious covering, the solution being diluted so as to contain not over 5 or 6 p.c of the gas.

The stronger water of ammonia is one of the most rapid and certain counter-irritants, and as it is often needed in important emergencies, it should be kept with great care, in a cool place, so as to preserve its strength for sudden demands upon it.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. MARCH, 1885. No. 8.

CORRECTION.

The article on hydrochlorate of cocaine in the last number of these pamphlets contains a serious typographical error through faulty proof-reading, at page 719, third line from the bottom, where the sulphuric acid used is given as of a s.g. 1.483. This was intended to be s.g. 1.843,—that is, the officinal sulphuric acid of the U. S. Pharmacopœia.

Again, the writer is much obliged to Mr. Henry B. Parsons, for pointing out another serious arithemetical blunder in the line above the s.g., or the fourth from the bottom. Here it is directed that the alcohol used should be acidulated with "one fifty-eighth to one sixtieth of its weight" of the acid, with the statement that this is practically equivalent to 12 grains of the acid to each pound of the alcohol. This latter is the correct proportion to be used, but it is by no means equivalent to the first proportion given, and is only about the tenth part of it. Instead of one fifty-eighth to one sixtieth, it should read one five hundred and eightieth to one six hundredth of its weight of acid, and this is equivalent to ·17 p.c., as given on the next page, 720.

Farther experience with the process has shown that there is an important advantage in having the coca in fine powder. It is quite difficult to exhaust at best, and requires a large quantity of menstruum, but when in fine powder the exhaustion is easier, and the yield larger. Therefore, on line 6th from the bottom of the same page a correction should be made to No. 60 sieve instead of No. 20. Those who preserve these pamphlets should turn to page 719 and correct these errors at once.

OLEATE OF COCAINE.

Read at the First Meeting of the Fifth District Branch of The New York State Medical Association, By E. R. Squibb, M. D.

The decided effects of cocaine salts as local anæsthetics when applied to the mucous membranes, at once suggested their application as local anæsthetics to the skin, so that by its use minor operations, analagous to those upon the eye, throat, urethra, etc., might be done without pain, or with diminished pain. And, if cocaine could be successfully applied to benumbing the skin, it would, of course, be applicable to local neuralgias and painful conditions which were of a local and superficial character.

The aqueous solutions of the soluble salts, of various strengths, were promptly tried upon the skin for the excision of tumors and for the relief of pain in inflammatory conditions, with published results which are very discrepant and confusing, but in a large majority of cases the solutions, of whatever strength, seem to have little effect as local anæsthetics when applied to the skin, though the same solutions have a very prompt effect when applied to mucous membrane.

As the chief difference between the skin and mucous membrane, in their relations to the anæsthetic, is the difference between the epidermis and epithelium, it is reasonable to suppose that the difficulty lies in the impermeability or slow permeability of the epidermis to aqueous solutions. And, if this be the obstruction to its anæsthetic effect on the skin, then if the alkaloid could be dissolved in some liquid which would pass through the epidermis as rapidly and as easily as aqueous solutions do through the epithelium, the effect of the agent carried by the solvent would be the same in one case as the other. But there is no solvent or liquid which acts through the epidermis, or passes through it, with anything like the facility that watery solutions act on, or pass through the epithelium, because a main physiological use or function of the epidermis is to prevent or obstruct rapid absorption, while the chief function of the epithelium is to promote rapid absorption. The net effect of this structural difference, in its relations to local anæsthesia, is that the sensitive terminal bulbs or papillæ are in the one case covered with a horny film slowly penetrable to liquids, and intended for protection against rapid absorption, while in the other case the sensitive papillæ are practically uncovered. It is easy to understand

that it would be impossible for the local anæsthetic to act through a finger nail, and therefore that it would act with difficulty, if at all, through a structure similar to the finger nail, only very much thinner.

Again, in acting through the epithelium the rate of absorption and dilution is such that the maximum effect is reached in a few minutes, and diminishes almost as rapidly as it increased. Now, if through the epidermis the rate of absorption be slower, while the rate of dilution and diminution in effect be the same, the agent would be washed away into the general circulation as fast as it could get through the epidermis, and therefore would yield the effect of only a very small quantity at any time, even throughout a prolonged application.

Hence, unless some solvent for the alkaloid can be found which will pass through the epidermis as rapidly, or nearly as rapidly as the watery solutions pass through the epithelium, the applications to the skin will fail in producing local anæsthesia, except by hypodermic use, and this use does not promise very much.

There is no liquid solvent known, nor easily conceivable, under the conditions of the problem,—which will pass through the epidermis as rapidly as watery solutions do through the epithelium. But if there be a solution which will pass through one-seventh as fast, and this solution can be made seven times stronger than an effective watery solution, everything else being equal, the conditions of the problem will be satisfied, and an equal degree of anæsthesia should result.

From the earliest times fats and oils have been used as vehicles in dermic medication, but the rate of absorption, and therefore the rate of medication by their use as solvents. has always been slow. Hence their use has generally been confined to the medication of the skin itself, and but rarely applied for constitutional effect, through absorption into the general circulation. These fats and oils can all be split by heat and pressure into the fatty acids and glycerin, and therefore are regarded as salts of the fatty acids, glycerin acting the part of a saturating base. The more liquid of the fatty acids, or those which are most fluid at the temperature of the skin, have long been known to pass through the cuticle or horny epidermis more readily and more rapidly than even the most fluid of the fats and oils. These facts apparently led up to the use of oleic acid, and oleates of various bases,—not in treating diseases of the skin where fats and oils are almost equally applicable,—but

in the medication of deeper tissues, or of the general circulating fluids, by absorption through the sound and normal skin. This medication by means of oleates of medicinal bases appears to have originated with Mr. John Marshall, F.R.S., and was first described in a "Clinical Lecture on the Treatment of 'Persistent' Inflammation by the Local Application of Solutions of the Oleates of Mercury and Morphia. Delivered at University College Hospital (London), March 16th, 1872." See London *Lancet* for 1872, p. 398.

Early in 1873 this writer took up the subject of the oleates, and on July 1st of that year a series of them was offered for medicinal use.

In September of 1873, an article appeared in the "Bulletin Générale de Thérapeutique," by Arthur V. Harlingen, M.D., "On the Oleo-stearates, and Particularly on the Oleo-stearate of Zinc," and from this time a constantly increasing number of oleates have come into use, for two different purposes: first, for local medication of the deeper tissues, and for general medication through the circulation by their absorption through the sound, healthy skin; and, much later, for local and superficial medication in skin diseases.

Immediately upon the discovery of the local anæsthetic effects of cocaine salts upon the mucous membranes, and of the failure of aqueous solutions of the salts when applied to the skin, it occurred to the writer that an oleate of the alkaloid would be a successful application for producing a local anæsthesia of the skin, and possibly of adjacent tissues, provided an oleate could be made of sufficient strength to counterbalance, by quantity and concentration, the slowness of absorption through the cuticle. But up to the present time, February 1st, the salts have been in such demand that a sufficient quantity of cocaine could not be spared for the necessary experiments in making and applying the oleate. Later, however, when the writer's stock of the alkaloid was better, and so much lower in price, the experiments now to be described were made.

The equivalent or combining number of the alkaloid cocaine is given differently by the three best authorities on the subject, but the more recent and possibly the best formula is $C_{17}H_{21}NO_4=303$ as the combining number for the crystallized alkaloid. It is a curious coincidence that this is the exact figure given for the crystallized alkaloid morphine, but as crystallized morphine loses one molecule of water on being dried above 100° C., and crystallized

cocaine appears to lose none at the same temperature, the elements of the morphine are differently divided. Its formula is $C_{17}H_{19}NO_3$ H_2O=303.

The combining number for oleic acid, as given by all good authorities, is 282, this being the sum of the formula $HC_{18}H_{33}O_2$.

If these figures be correct,—which, so far as cocaine is concerned at least, is doubtful,—a normal oleate of cocaine requires 303 parts, by weight, of cocaine, and 282 of oleic acid, and the salt is represented by the number (303+282=) 585, and it contains 51.794+ p.c. of the alkaloid. Where the two substances are put together in this proportion, and rubbed and digested together, a pasty mixture results, in which a part of the alkaloid appears to be uncombined. By the gradual addition of oleic acid with trituration, digestion and very gentle warming, a transparent solution of the salt in an excess of oleic acid is obtained, which remains very nearly transparent when cooled to ordinary temperatures, with a proportion of the alkaloid equal to 33 p.c. In one trial this solution repeatedly crystallized to a lardaceous mass, too thick to pour at ordinary room temperatures, and it is probable that all would do this in time when of this strength. It was therefore farther reduced by the addition of oleic acid until the proportion of the alkaloid was 25 p.c. This gives a composition for the solution of about 48.26 p.c. of normal oleate of cocaine dissolved in 51.74 p.c. of free oleic acid.

As the hydrochlorate of cocaine is said, by authorities, to contain 88.78 p.c. of the alkaloid and 11.22 p.c. of the acid, the 4 p.c. aqueous solution of this salt should contain 3.55+ p.c. of the alkaloid, and hence a solution of the oleate in oleic acid containing 25 p.c. of the alkaloid would be just about (25÷3.5512=) 7 times the alkaloid strength of the 4 p.c. aqueous solution that is in common use for application to mucous surfaces. And hence if such a solution of the oleate should pass through the cuticle at one-seventh the rate that a 4 p.c. aqueous solution passes through the epithelium, and if the terminal papillæ of the skin and of the mucous membrane were equally sensitive to the action of the alkaloid, an equally prompt and profound anæsthesia should result; and such a result might rationally be expected.

This solution of oleate of cocaine in oleic acid containing 25 p.c. of the alkaloid, and hereafter called simply oleate of cocaine, is very easily made, as follows:

Take of Cocaine,	- - -	1 part.
Oleic Acid,	- - -	3 parts.

The cocaine used should be precipitated from an aqueous solution of the hydrochlorate or sulphate of cocaine by solution of carbonate of sodium. The precipitate collected upon a filter, should be well washed and thoroughly dried at a temperature not above 50° C., or 122° F.

The two substances should be weighed in a counter-balanced mortar with pestle, and be then rubbed together thoroughly. A large proportion of the alkaloid dissolves promptly in the oleic acid with slight effervescence of air and carbonic acid, but a small proportion does not dissolve so readily, and therefore the mortar should stand for a few hours, with occasional trituration, until the solution is complete. The whole is then gently warmed in order to render it more fluid, that it may be poured into the receiving bottle with the least possible loss.

The alkaloid used for the oleate need not be white ; indeed, it is wasteful to decolorize the alkaloid for this use, since decolorization does not improve its activity, and the oleic acid is always colored.

In dissolving the alkaloid in the acid there is a slight loss in weight, noticeable only when the scale is a sensitive one, and the quantity of alkaloid taken reaches ten grammes, or thereabout,—the loss being probably due to the escape of a small quantity of carbonic acid which had been combined with the alkaloid.

This oleate of cocaine is a liquid of syrupy consistence, not perfectly transparent when cold, though very nearly so. The color is very nearly that of the oleic acid from which it is made—generally that of ordinary sherry wine. It has the odor of the oleic acid of which it is made, and this, if the acid be good, is not pungent or disagreeable. A very small fraction of a drop transferred to the tongue on the point of a pin gives instantly the bitter taste, and almost instantly a characteristic numb spot. This spot increases in size in a few moments, reaches the maximum impression in about five minutes, and continues for ten or fifteen minutes, according to the quantity put upon the tongue. The quantity taken was found to be less than a tenth of a grain to give this result, so that half a grain, or half a minim, would probably anæsthetize a square inch of dry mucous membrane.

It is a very costly preparation, for, even at the present moderate price of 30 cents per grain, or $4.50 per gramme for the hydrochlorate, this oleate would cost about one-third of that, or ten cents per grain or minim, or $6 per fluidrachm. Yet, should it be found to be useful, the quantity required is so very small, and waste so

easily controlled, that it would probably be more economical for some purposes than the watery solution, because hardly more than a drop or two could ever be required at a time, and it would not run off the parts nor be diluted and washed away by watery secretions, as often happens in the use of aqueous solutions.

This oleate was used in the following experiments to ascertain its effects upon the sound and healthy skin.

After many preliminary trials to learn what to do and how to do it, it was found that the small quantities required for application could be pretty closely measured by the use of a common pin. A drop from an ordinary vial was found to be about ·043 gram, or two-thirds of a grain, thus containing, of course, about one centigramme of the alkaloid, or about ·16 grain, and this upon a piece of filtering paper makes a round spot nearly two inches in diameter, and would easily cover that much surface of skin or mucous membrane,—not drying there as the watery solutions do, but remaining moist until absorbed. An ordinary pin, held by the point, when the head and about one-third of the shaft is dipped into the oleate withdraws just about ·002 gram, or one thirty-third part of a grain, and this amount spread over the surface by means of the head, easily covers a spot half an inch in diameter. This was the quantity used in all the final trials. When applied to the upper surface of the protruded tongue which had been freed from moisture as far as practicable, and the spot watched with a lens of about two inches focal distance, the sides of the papillæ and the interspaces between them were slowly blanched, making the red spot at the top of each papilla look larger and redder by contrast, but the general appearance of the spot seen without the glass was not sufficiently changed to be distinguished from the surrounding surface. No numbness, nor any sensation, nor any taste was felt, and when tested by light pricks with a pin point, there was no very distinct difference in sensation between the spot and the surrounding surface. The tongue could only be kept under observation in this position for about five minutes, and when taken into the mouth and applied to the roof of the mouth, the bitter taste and numbness were at once felt. The bitterness soon disappeared, but the numbness extended throughout the mouth and to a slight extent into the fauces, and had not entirely disappeared from the primary spot on the tongue in half an hour. At no time, however, could any cutting operation have been done upon the spot without pain, or with any great diminution of the natural degree of pain. A similar application to the lip,

covering surface both within and without the line of mucous membrane, gave first a very slight sense of coolness,—absent in some observations, and very slight in any,—no perceptible change in color, and very slight if any diminution of sensibility to light pricking with a pin point, when compared with the surrounding surface, the observation extending through half an hour. The tongue applied to that part of the lip at the end of this time at once perceived the bitter taste, and the characteristic numbness began in the tongue within a minute. To the tongue when first applied, the lip felt slightly numb. This experiment was repeated with the 4 p.c. solution of the hydrochlorate, with negative result upon the lip, and much weaker effect on the tongue.

A portion of the skin of the back of the hand large enough for two spots, with an intervening space, was selected and examined with a compound lens of about half inch focal distance. Such a glass, in a strong light, shows all the capillary vessels which carry red blood, after the cuticle has been rendered transparent by oleic acid. The sensitiveness having been judged of by very light prickings over the surface with a dull pin point, two spots were made, in a line across the hand, the one with oleic acid and the other with the oleate, and these were observed during an hour with the aid of the glass. The surface in both was studded, not very thickly, with red points, from a few of which branching, tortuous vessels came off, interlacing and anastomosing, leaving numerous spaces which were free from visible vessels. After about ten minutes a slight difference was indistinctly perceived between the spots, and in twenty minutes this difference was perhaps a little more distinct, but after that there was no apparent change. In the oleic acid spot the superficial vessels either remained as at first, or if changed at all, they were rather increased, so as to increase the general blush of the skin. In the oleate spot the vessels and red points seemed unchanged, but the intervening spaces looked paler than at first, and paler than in the other spot, giving the surface a slightly mottled appearance. But the total difference between the two spots was so slight as to require very close observation, and after these were repeated, still leave room for doubt. In testing the sensibility of the spots in comparison with the surrounding surface, by means of a dull pin point, and by pulling upon the hairs, the oleate spot seemed to be slightly less sensitive, though this was not beyond doubt. No discoverable point, however small, had a sufficiently diminished sensibility to be sure that it was diminished at all,—no sensible approach to local anæsthesia.

These trials were carefully and elaborately repeated upon the thinner and more delicate skin on the inside of the fore-arm, but with the same negative results. Finally, a trial was made in which a double quantity was used on bibulous paper, under an impervious covering, to start with, and this was reinforced with a single quantity each hour for three hours, so that there should be no mistake in the sufficiency of both the quantity and time for action, but the result was again negative as before. This final trial was repeated with an aqueous solution of the hydrochlorate containing 25 p.c. of the alkaloid, but with the same negative result.

The conclusion thus reached is that hydrochlorate and oleate of cocaine, though both anæsthetic to some mucous membranes, and effectively sedative to all, are nearly or quite without effect in diminishing sensation in the healthy skin, and thus the rational expectation that the oleate of cocaine would prove to be a local anæsthetic of sufficient power to mitigate the pain in minor operations where the sensitiveness of the skin is the chief cause of suffering, is disappointed.

It is true that the oleate may have some advantages over the aqueous solution of the hydrochlorate in a few uses that can be foreseen, as for example, about the anus, glans penis, anterior nares, etc., but these are so few, that short of some new developments in its favor in actual practice, it must be considered as a useless preparation.

As yet there has been no opportunity of demonstrating the effect, or want of effect, of cocaine on trigeminal neuralgias. Their successful treatment does not depend upon anæsthesia of the part, but rather upon an unknown condition of narcosis or sedation which leaves the general sensibility intact, as, for example, in the occasional success of oleates of aconitia, or veratria and of menthol,—and many have hoped that cocaine might be available in some of these very difficult cases. The watery solution, however, has been tried in vain, though perhaps not fairly nor conclusively tried, because it evaporates rapidly, and does not get through the cuticle. Here the application of the oleate would be more conclusive one way or the other, as it does not evaporate, and does pass through the cuticle slowly. A small piece of paper, or thin muslin, moistened with the oleate, pressed upon the painful spot, will adhere and will supply the agent to continuous absorption, as the watery solution will not do.

In sensitive, abraided surfaces and ulcerations where there is little inflammatory action, but only irritability, the oleate might be

tried with some chance of utility. But inflammatory pain, or any conditions where there are enlarged and turgid blood vessels, seem to be beyond the reach of cocaine in any form, even if the pain or inflammation be in mucous membranes. It seems to be the pain and hyperæsthesia of irritation, short of greatly increased redness and swelling, in which cocaine is most effective.

In regard to the important class of oleates in general, there is one error that is repeated so often, both in this country and Great Britain, that it may be worth a repeated correction, even though it be quixotic to fight the windmills of popular error. The current statement referred to is that when bases are dissolved in oleic acid true oleates of these bases are not formed, but that the bases are simply held in solution in the liquid,—meaning by this that they are not combined as true salts, and are therefore improperly called oleates, and that true oleates can only be made by double decomposition. This statement started as an ingenious advertisement for oleates made by double decomposition as against those made by the direct union of the elements, and was all well enough as an advertisement, because about as accurate and true as advertisements in general, but that good medical authorities and periodicals should go on repeating and spreading the erroneous statements now, when oleates are in such general use, and so well understood, is remarkable.

The statement can be very easily disproved by demonstration by any one who requires this kind of proof, but to most persons with education enough to be convinced by a well-known illustration, it will be only necessary for them to think whether or not a true salt be formed,—or whether combination takes place,—when oxide of mercury is dissolved in nitric acid instead of oleic. There are very few who will doubt that nitrate of mercury is formed in one case, and there is no more reason to doubt that oleate of mercury is formed in the other.

For the treatment of some skin diseases, or probably most skin diseases, where absorption is not desirable, it may be best to avoid an excess of oleic acid, and substitute, as a vehicle, some more bland and more consistent substance, and then the oleates made by double decomposition, and therefore containing no excess of acid, when mixed with such vehicles as soft paraffin or lard, may be preferable, because a topical dressing only is wanted. But oleates which are to

be applied to the sound skin for the medication of deeper tissues, which was their original design and use, and still is the main object of their application, there is no vehicle which introduces them so well as the excess of oleic acid, which holds them in so perfect a solution. And there is no way of making oleates that is so direct, so simple and so economical, as by direct combination. Any one can make them in this way, and it is better that as many pharmacists and physicians as possible should make them, because then they are freshly made as used, and are generally fresh and in good condition.

THE MARKET FOR COCA AND COCAINE.

Coca leaves still continue to be very scarce and very high in price, both in this country and Europe, and those which are accessible are of very poor quality. With the exception of one or two small lots of green leaves adapted to pharmaceutical uses, not amounting, in the aggregate, to more than one to two hundred pounds, and which were selling slowly at about $2.25 per pound, the remaining larger lots were held at from $1.25 to $1.50 per pound, with the expectation of still higher prices, when the cocaine makers should get short and have to buy. Each time the makers did buy, they of course selected the best lots, each time paying higher prices, until finally the highest prices were reached, and that for the lowest grades of quality, which remained over from former selections. In this condition of market, and with the holders' story still current that no fresh shipments could reach here until May, there arrived about the middle of February a lot of about eight bales of 100 lbs. each, of fresh leaves,—not of very good quality, but still very much better than any here. This lot was promptly offered by sample from two or three different quarters at $1.25, $1.40 and $1.50 per pound, and was still unsold about March 1st, probably because it was not worth the price in any other sense than that of being much better than the old lots with which it was in competition. Another probable reason why it did not sell promptly, was that it broke the current story that new shipments were impossible till May. And still another reason might have been that the makers, who found the May story might be true, had taken care to supply themselves pretty well against that contingency.

The writer, and some friends of his in the Navy, who were fa-

miliar with the western coast of South America, had written to correspondents there for information in regard to coca, and about February 25th the first intelligence was received, in reply, from Dr. W. H. Jones, of the Navy, the Surgeon of the U. S. S. Wachusett, to Dr. L. J. Williams, U. S. N., of Baltimore. From Dr. Jones' very full and interesting letter, and from another letter from the U. S. Consular agent at Arica, it is found that the best coca is produced in Bolivia, east of the mountain range,—that it is brought across the mountains for several hundred miles on the backs of pack animals to Tacna, and thence by railroad about 40 miles to Arica,—and that the rainy season from January to May renders the long transportation somewhat risky on account of damage by wetting. The original packages of 45 to 50 pounds are called "tambores," and these, after having crossed the mountains to easier transportation, are put two or more together into bales, and are thus exported. The leaves are, especially when compressed in large bales, very sensitive to dampness and heat ; and, however green and good at the start, and whatever precautions be taken on the bills of lading to secure cool and dry transportation, they are always damaged somewhat, and often very much,—much more than by the long trip across the mountains in small parcels. Bolivian coca of good quality is always dear, probably from the long and expensive journey to the seaports, and Dr. Jones says that in the shops along the coast it sells at 80 cents to $1.00 per pound.

Mr. Dauelsberg, the Consular agent, who has dealt in Bolivian coca for many years, sends mail samples of good quality, and says that, lately, in order to secure the quality, the leaves are repacked in tins for transportation. The mail samples sent are so different in appearance from the coca commonly met with here, as to raise a doubt whether good Bolivian coca ever reaches this market. The leaves are much more uniform in shape and size than those ordinarily met with, and although not of a very bright green color, are much more uniform in color, and are less broken up. But the greatest difference noticeable is in the characteristic creases which mark the back of the leaf, extending on each side of the midrib, in an elliptical curve from the point to the footstalk. In all the coca of this market these characteristic creases are wanting in a small proportion of the leaves ; but being of all degrees of faintness in other leaves, their absence cannot be considered as excluding the leaves from being the product of the coca plant, but that they vary under different conditions of climate, soil, etc. Bentley

and Trimen, "Medicinal Plants," Vol. I., Article 40, say: "It is scarcely possible to mistake the leaves of coca for those of any other plant—the two longitudinal arched lines on the under surface being characteristic. These, which are found in several other species of Erythroxylon, are not, as often described, veins or nerves, but folds or creases produced by the mode in which the leaves are packed in the bud."

In the mail sample of Bolivian coca, however, not a single leaf could be found without this characteristic, and in very few leaves was it so faint as to require very close inspection. Another difference in this sample is that in some of the larger and older leaves the footstalk and midrib have the red color, which in the wood of some species gives the generic name Erythroxylon, or red-wood.

Neither Dr. Jones nor Mr. Dauelsberg say a word about the new crop in May story, but leave their readers to the inference that the high prices here and in Europe have cleaned out the seaport towns along the coast, and that with the characteristic slowness of the people and their modes of transportation, it takes some time to re-supply them. As the reports of the high prices reach the interior, however, the probabilities are in favor of an over supply.

The market supply of cocaine salt has, for some time past, been abundant, and it is highly probable that all the principal makers have a good stock on hand. The former high prices seem to have had the effect of rapidly diminishing the less rational uses of the agent, and of restricting it to the limited special uses to which it is applicable, and when thus limited the demand fell off,—or, at least, did not increase,—while the amount manufactured continued to increase until the stock on hand became probably sufficient for several months' supply.

It is probable that the few makers soon found out by experience with their processes, that even the leaves of poor quality gave larger yields than had been expected, and that the difficulties of extraction grew less and less with experience in the management of details, so that the supply became greater than the demand, and stocks thus accumulated. This, of course, led to a reduction in price and the abandonment of the very unreasonable prices caused by the first sensational demand. Under this improved condition of both demand and supply, the price of the hydrochlorate fell, in the wholesale market, from 50c. per grain, or $7.50 per gramme, to about 30c. per grain, or $4.50 per gramme. The writer can say nothing of the processes of other makers, but by his process, as given in the last

number of these pamphlets, somewhat improved in detail by experience,—with even moderately good coca at say 90c. to $1.00 per pound, it can be produced at this lower price, with a fair manufacturer's profit, but cannot be produced at a lower price until better coca at lower prices is accessible. How soon this latter condition of market may be reached no one can tell, but the stocks on hand will probably insure the stability of the lower prices for a month or two at least, since the demand will be more likely to diminish than increase as the enthusiastic expectations in regard to its powers and uses are disappointed.

COCAINE IN DENTAL OPERATIONS.

Upon noticing the many very definite statements published in regard to the anæsthetic effect of the hydrochlorate of cocaine upon sensitive teeth,—curing tooth-ache at once, and enabling very tender diseased teeth to be excavated and filled without pain, the writer sent a 4 p.c. solution to his friend, Dr. T. B. Gunning, whose opportunities for trying it, and whose habits of close observation were well known. After a full trial of the solution in every way that his skill could suggest, Dr. G. wrote, in substance, that in the excavation of sensitive teeth he could get no patient to acknowledge to the least diminution of the pain. He wrote at the same time that the same negative results had been reported to the British Dental Association, but that at the same time, to the same body, it was reported that a 20 p.c. solution was effective in the same conditions. A 20 p.c. solution was at once made and sent for trial. It was tried with the report that in the cavities of teeth it was no better than the 4 p.c. solution,—that it was of no utility,—and from these disappointing results the conclusion reached was "that but little advantage will result from this new discovery as far as dental operations are concerned."

One instance has been heard of that may account for the good results obtained in other hands, and it will apply equally to reported good results in minor surgery. A lady with a tender tooth to be excavated was assured by the operator that he had this new and wonderful discovery, cocaine, and would apply it to her tooth, when the operation would be almost painless. On returning home the patient reported that she had suffered very much, but supposed she would have suffered four times as much had the wonderful new

remedy not been applied. Similar results will frequently be reached, and their definiteness will be proportionate to the preconceived confidence of the patient in the operator and the remedy.

COCAINE ON THE OPIUM HABIT.

The writer has for many years had a correspondence, taking up a good deal of time, in relation to "cures" for the Opium habit, and lately this correspondence has increased, and refers to the use of coca or cocaine as this long sought "cure." These letters are generally from physicians, but not unfrequently from subjects of the habit or their friends, and the old, old story of having tried the various advertised and vaunted "cures," with the result of finding either that they did no good, or that the cures were themselves some preparations of opium or morphine, the net result being only money in the pockets of the quacks. Cases which appear to be "cured" by the quacks, and there are such,—must in reality recover only through the courage and the perseverance of the subjects themselves.

Many physicians, as well as the subjects of the habit and their friends, lose sight of the circumstance that this habit is a vice, like the alcohol habit, and not a bodily disease to be dosed,—and this vice absolutely beyond the scope and reach of medication. Almost as well might they expect to cure lying or stealing by doses of drugs. The writer, in common with many others, has known many cases of this habit, and some recoveries from it, but never knew a single recovery that was not due to the moral courage of the subject of the habit. Nowhere are the lines of Cowper more applicable :

> "Habits are soon assumed ; but when we strive
> To strip them, 'tis being flayed alive."

And it is this being flayed alive that many subjects of this vice refuse to summon courage enough to submit to. Many do this in every stage of the habit, and all might do it if they would, and "cures" by drugs are only sought through some degree of moral degradation or cowardice, which gives an alluring, but false idea of the word "cure."

Subjects who will morally train themselves up to take hold of themselves, can break the habit either abruptly or gradually, and will recover from its dominion and its effects. Those who will not

do this, doom themselves to certain moral and physical destruction. With sufficient courage no help is needed; without it all help is in vain. Restraint either in or out of Inebriate asylums or hospitals may aid effectively in breaking the habit, if a good degree of moral courage be summoned as a basis for action; but without moral courage, restraint must be perpetual to be of any use.

When a subject has courage enough, and is in earnest to begin a vigorous campaign against his habit, he soon reaches a stage analagous to the delirium tremens of the alcohol habit, and here the wise and careful physician may be needed, and medication is often available, the more effective of the nervous stimulants and restoratives being the best agents. To tide over the period of greatest suffering and to relieve it somewhat, whether it be for a day or two, or for a week or two, is quite within the reach of the materia medica, and different agents will be more or less effective in different cases. Alcohol, cannabis indica, coffee, tea, etc., are all available, and in this class coca will take a place, but probably not as a prominent agent. But the salts of the alkaloid cocaine are not likely to be of any use.

BISMUTH.

This metal was the subject of a note at page 656 of these pamphlets, and in September, when that was written, there had been a sharp advance in price to about $1.60 per pound, and this was supposed to be the result of a combination of the three sources of supply of this metal. It had been doubtful before, whether a combination could be effected in London, but the sharp advance was supposed to indicate that result. This price was, however, not long maintained, but fell off from some unknown cause until near the end of the year, when it had again reached the neighborhood of about five shillings, or $1.25 per pound, and this price appeared to be pretty steady until about the middle of January, when, without any warning indications of unsteadiness or any appearance of scarcity, the price in London was put up three shillings a pound at one stroke. The market story, to account for this sudden movement, was that there was but little Australian bismuth in the market, and the Bolivian supply was suspended until May, thus leaving Saxony as the only source of supply, and that the Saxon interest had put up the price. The more probable explanation was, however, that the market had been manipulated for a speculation.

Speculators with private sources of information might have been quietly loading themselves up at the lower prices, and when they got the market bare,—the corner completed,—they "shook" the market,—that is, scared consumers into their sudden advance. Had this been the case, the speculators would have "unloaded" at the high price within two or three weeks, and their object accomplished, the price would have fallen off again and perhaps almost as suddenly gone back to the former figures. This was the writer's theory, but he seems to have been mistaken, as the high price is still maintained with apparent, though with possibly illusive firmness. Should it remain at this very high figure, the rational inference will be that the three sources of supply have a firm combination or monopoly established.

Throughout all these fluctuations of many years past, with no periods of very low prices, and with abundance of capital seeking investment, nothing is heard of opening any of the many sources of bismuth in this country. Not very long ago specimens of ore were seen in this market much like the Australian ores, only richer. Some 50 or 60 p.c. of bismuth ran out of the ore at a moderate heat, leaving silver and gold enough in the slag to pay all expenses. It seems very remarkable that such interests are so slow in being developed in this country.

THE PHARMACOPŒIA OF 1880.

(Review Continued.)

The aromatic waters of the Pharmacopœia, like many other of its weaker preparations, are falling into disuse, and when used now it is chiefly as vehicles or flavoring adjuvants. For such purposes they are very useful and therefore not unimportant, but the writer knows nothing about them, nor about the new and ingenious process for preparing many of them by the use of cotton.

Camphor water and chlorine water are, however, of more importance and deserve more attention than the writer's imperfect knowledge of them can supply.

AQUA CREASOTI.

CREASOTE WATER.

Creasote, *one part*.	1
Distilled Water, *ninety-nine parts*.....	99
To make *one hundred parts*,.....	100

Agitate the Creasote with the Distilled Water until dissolved, and filter through a well wetted filter.

The officinal Aqua Creasoti, or Creasote Water, is so important a preparation for one special use that it is well to notice it in order to emphasize that special use. It is a simple 1 p.c. solution of wood creasote in water, and like similar solutions of carbolic acid and of cresol, it is a most effective local anæsthetic, and topical dressing to burns and scalds. It is no better than the solutions of carbolic acid, or of coal-tar creasote, for this purpose, but is quite as good, so that whichever is most accessible or most convenient may be used. This creasote water, as made by the above formula,—or diluted with an equal volume of water, or with more water for delicate surfaces in women and children,—and applied by means of a single thickness of thin muslin, or worn out cotton or linen, such as handkerchief stuff, and the application renewed from time to time, as the return of pain requires it,—will relieve the pain of burns and scalds in five to ten minutes, and will maintain the relief as long as the applications are properly renewed, or until the painful stage is over.

It is also very effective as a local anæsthetic for general use in all painful conditions which affect the surface only, such as the pain of erysipelas. The benumbing effect of these phenols upon the skin is very promptly reached, and can be carried to almost any degree that is desirable, by simple management of the strength of the solutions and the mode of application. They are true anæsthetics to the skin, while the much lauded cocaine is not.

This statement has been published so often during the past twenty years, and the treatment has been so effective in so many hands, that it is wonderful to notice how the common practice is still to use the old and comparatively useless and hot dressings, such as carron oil, white lead ground in oil, flour, liniments, etc, or the newer application of solution of bicarbonate of sodium.

CYANIDE OF SILVER. The description and tests of this salt appear to be full and sufficient. Its only use in medicine is for the extemporaneous preparation of Diluted Hydrocyanic Acid, and is so rarely used for this purpose, that it is quite unimportant.

IODIDE OF SILVER. This is a new officinal salt of this Pharmacopœia, for which the writer knows no use in medicine. No reason has ever

been give for its introduction, and it appears to be not simply surplussage, but an incumbrance.

NITRATE OF SILVER. The description and tests of this salt are very full, and entirely sufficient. It is, however, often found in a granular form that has gradually become somewhat popular from its convenience in weighing out for medical and pharmaceutical uses. This form is attained by first getting the solution entirely pure, and then evaporating it to dryness with constant stirring. The salt is then better than when in tabular crystals, because it is dryer, and freer from the slight impurities which the mother-liquor leaves in the interstices of the larger crystals. In the granular condition the color is less changed by light.

DILUTED NITRATE OF SILVER. This is really diluted fused nitrate of silver, but the word "fused" or "moulded" was probably left out by the committee to shorten the name for more convenient use. But fused or moulded nitrate of silver and potassium might have been a better name. The common name, not given, but the one by which it is very commonly ordered, is Mitigated Nitrate of Silver. The officinal salt contains 50 p.c. of nitrate of silver, but a strength which is commonly used, and which seems to be growing in favor, is made with 33 p.c. of the silver salt. It is often moulded in cones or points well adapted to use in caustic holders, and in this form it is more economical than when in sticks, as well as more convenient.

ARGENTI NITRAS FUSUS.

MOULDED NITRATE OF SILVER.

Nitrate of Silver, *one hundred parts*	100
Hydrochloric Acid, *four parts*	4

Melt the Nitrate of Silver in a porcelain capsule, at as low a temperature as possible ; then add to it, gradually, the Hydrochloric Acid, stir well, and, when nitrous vapors cease to be evolved, pour the melted mass into suitable moulds.

Keep the product in dark amber-colored vials protected from light.

A white, hard solid, generally in form of pencils or cones of a fibrous fracture, becoming gray or grayish-black on exposure to light in presence of organic matter, odorless, having a bitter, caustic and strongly metallic taste, and

a neutral reaction. Soluble, with the exception of about 5 per cent. of chloride of silver, in 0.6 part of water and in 25 parts of alcohol at 15° C. (59° F.), in 0.5 part of boiling water, and in 5 parts of boiling alcohol. It is insoluble in ether. Whatever is left undissolved by water is completely soluble in water of ammonia.

A filtered aqueous solution of 2 Gm. of the salt, acidulated with nitric acid, when completely precipitated by hydrochloric acid, should yield 1.6 Gm. of dry chloride of silver.

The Latin title, Argenti Nitras Fusus, is the same as in former revisions, and no reasons have been given for changing the English name from Fused Nitrate of Silver. If the change be of doubtful utility, it is bad, simply because it is a change. But the salt is also changed in quality by containing about 5 p.c. of chloride of silver. About 1856 it was observed by Dr. J. Lawrence Smith, of Louisville, Ky., that the presence of a small proportion of chloride of silver in the fused nitrate rendered it much tougher, and less freely soluble; and as the breaking of the sticks then used was always a waste, and often a dangerous disadvantage, it became quite important to have them thus made at least 25 p.c. stronger. Then, again, the very rapid and easy solubility of the pure nitrate made it difficult to apply a small enough quantity, or to limit the application to a small area, and so it became equally important to diminish the solubility somewhat. Dr. Smith, however, used chloride of sodium for admixture with the silver salt, thus introducing nitrate of sodium, which was not desirable. The writer used instead, an amount of hydrochloric acid sufficient to give a proportion of 5 p.c. of chloride of silver, and after the compound salt had been well tried, and its advantages proven, he, in 1858, recommended it for adoption in the Pharmacopœia of 1860. (See Proceedings of The Amer. Pharm. Ass'n for 1858, p. 409.) It was, however, not adopted by the Committee, but was made and offered for use by the writer, being distinguished from the officinal fused nitrate by the name "Fused Nitrate of Silver with Chloride." It, as well as the officinal salt, was cast in small, pointed cones for caustic holders, and the two were offered at the same price. It gradually came into pretty general use, and for many uses was greatly preferred, so that in the twenty-five years since it was first made, its advantages are now sufficiently appreciated to induce the Committee of 1880 to drop the old Fused Nitrate, and adopt this in its place, but under the old name. This is a doubtful policy, because it is always more or less dangerous to adopt a new preparation under an old name, and in view of the great redundancy of the Pharmacopœia, it would

have been much better to have retained the old, pure nitrate under its old title, and to have introduced the compound salt under a new title. Comparatively few physicians will know that when they order "Fused Nitrate of Silver," they should by rights now get what they formerly ordered as "Fused Nitrate of Silver with Chloride." But it is also probable that few pharmacists will observe the change. In practice, the writer has had both upon his list for many years, and as yet has seen no change in the relative quantities of the two ordered, by either physicians or pharmacists, since the new Pharmacopœia went into effect.

Many good pharmacists and physicians have been in the habit of using the small pieces of broken sticks and cones to make their solutions from, instead of buying the crystallized or granular salt for this purpose, and this practice was quite unobjectionable and very economical, because, with the utmost care in packing and transportation, some sticks and cones will be so broken as not to be available for use in caustic holders. But now, if the present officinal salt be used for solutions, the quantity taken must be one-twentieth greater than is ordered of nitrate of silver, and the chloride of silver must be filtered out of the solution ; and solutions which have been filtered through paper, although made with distilled water, as they always should be, turn black much more rapidly than those not filtered. From these circumstances it seems probable that the fragments of the officinal salt will no longer be utilized in this way, but will have to be, as they accumulate in sufficient quantity, dissolved in distilled water, the chloride filtered out, and the solution be evaporated to dryness with stirring, a little nitric acid being added in the drying to free the salt from organic matters. The chloride of silver filtered out will be wasted unless the quantity be sufficient to warrant a process for reduction. In consideration of these facts, the writer has not yet conformed to the new Pharmacopœia in sending out Fused Nitrate of Silver with Chloride, when simply Fused Nitrate of Silver is ordered, but has always sent the pure salt ; and this is perhaps technically justified from the fact that in orders the Latin title is rarely used, and the English officinal title is not Fused Nitrate of Silver, but Moulded Nitrate of Silver. Hence, when Fused Nitrate of Silver is ordered, it is not to be found in the Pharmacopœia, and therefore the pure substance to which alone, outside of the Pharmacopœia, this name can properly apply, may be, or must, in strictness, be supplied. But if the Latin title Argenti Nitras Fusas be used, then it is equally necessary, in strictness, not to

supply the pure salt, but to supply that containing chloride. This is a technical difficulty of no great importance here, but it is an excellent illustration of how easy it is for the Pharmacopœia to get into trouble, or throw the daily practice of a whole nation into trouble.

Fused Nitrate of Silver in the form of sticks has the disadvantage of being easily broken up in handling and in transportation, into pieces, many of which are too small for convenient use in a caustic holder; and for many uses these pieces have to be sharpened at the point, involving considerable skill and waste. There are two good ways of sharpening a stick of nitrate of silver. One is to hold it obliquely, applied to a piece of wet rag or paper, and by turning it and rubbing, wash away the square edges until it is sufficiently conical. Another is to heat a piece of silver coin on a lamp until the nitrate of silver fuses on being applied to the coin. Then by holding the piece obliquely and turning it, the edges are melted off to a cone shape. In either of these ways a very sharp point can be made if desirable, but there is no way of sharpening that is not wasteful.

More than twenty years ago the writer was the first maker to offer nitrate of silver moulded into short cones, the bases of which were of proper size for ordinary caustic holders, and such cones have now come into very general use. Moulds for cones are more costly and more expensive to keep in order, and there is more skilled labor required in using them, so that they are more costly than the sticks, but this greater cost is in appearance only, for the sticks being rolled in paper for their protection, are weighed paper and all, so that paper is bought at the price of nitrate of silver, while the cones are weighed net, or without anything around them. Then, again, the cones lose nothing in the first sharpening and have better points for use in delicate applications, such as the getting to the bottom of a fissure.

Fused nitrate of silver is liable to adulteration, and the adulterant is commonly nitrate of potassium. And diluted nitrate of silver is liable to be sold, by mistake or design, as pure nitrate. The tests given by which the silver is precipitated as chloride and weighed, will, of course, detect such adulteration. But a much easier test, proposed by the writer in 1858 (see "Proceedings of the Amer. Pharm. Asso'n," for that year, p. 409), will detect the adulteration qualitatively. If a very small quantity of the powdered nitrate in question be spread very thinly upon paper, and the

paper and nitrate be burned, the residue will be tasteless if the salt was pure. The carbon of the paper reduces the nitrate to metallic silver, which is tasteless, but if any fixed alkali be present, the carbonate formed by the combustion will give a saline taste. Of course, any form of carbon may be substituted for paper, and a little powdered sugar or starch mixed with the powdered nitrate, —but not powdered together, for fear of explosion,—and the mixture burned on a platinum foil, will do as well, or better ; and this simple procedure will often save the time and trouble of evaporating a filtrate, or drying and weighing the chloride.

OXIDE OF SILVER. This substance is of no general use in medicine, and therefore an incumbrance to the Pharmacopœia.

ARNICA FLOWERS AND ARNICA ROOT. The flowers were in the Secondary List up to 1860, when they were promoted to the Primary List, and now, in 1880, the root is added. Introduced, probably, from German popular, rather than professional use, in a time when popular faith could be put in a plant that was good for accidents, it has maintained a place and obtained a promotion to which it was probably never entitled ; or, rather, in all this half century or more of progressive scrutiny and observation in regard to medicinal substances, nothing that is at all definite can yet be said in regard to the utility of arnica. Immense quantities have been, and still are used in various pharmaceutical forms, with no more definite or exact knowledge than that it is popularly believed to be good for sprains and bruises. And it seems to be good for them on the general principle that there is no knowing how bad they would be if arnica was not used upon them.

ARSENII IODIDUM.

IODIDE OF ARSENIC.

[ARSENICI IODIDUM, *Pharm.*, 1870.]

AsI_3 ; 454.7. — $As\mathit{I}_3$; 454.7

Iodide of Arsenic should be kept in glass-stoppered vials, in a cool place.

Glossy, orange-red, crystalline masses, or shining, orange-red, crystalline scales, gradually losing iodine when exposed to the air, having an iodine-like odor and taste, and a neutral reaction. Soluble in 3.5 parts of water and in 10 parts of alcohol at 15° C. (59° F.) ; also soluble in ether and in disulphide of carbon. It is gradually decomposed by boiling water and by boiling alcohol.

By heat the salt is completely volatilized. The aqueous solution has a yellow color, and, on standing, gradually decomposes into arsenious and hydriodic acids. On passing hydrosulphuric acid through the solution, a lemon-yellow precipitate is thrown down. If the salt be heated with diluted nitric acid, vapor of iodine will be given off.

Preparation: Liquor Arsenii et Hydrargyri Iodidi.

The change here in the official Latin title is rather a striking one, but if more correct as it is, of course the change is a good one. The old title was adopted by the approval of several excellent Latin scholars, but may have been wrong notwithstanding. If there was reasonable doubt, however, the old title was best.

This is the teriodide of arsenic for the preparation of which a simple formula was given in the last Pharmacopœia, and as the description is so nearly the same as before, it may be presumed to be the same substance. In making it the triturated iodine and arsenic are melted in a flask by holding the flask in hot water, and when thoroughly melted the liquid is poured out upon a porcelain surface to cool and solidify in thin layers, the thin layers being obtained by motion of the liquid while cooling. This management gives the form of thick scales, smooth and somewhat glossy on one side,—that next the porcelain surface,—and rough and crystalline on the other, with crystalline fracture at the edges. When cooled in thicker layers, and more slowly, and then broken up, it has more the appearance of distinct crystals or groups of crystals. In the process a little iodine is lost by evaporation, and therefore a slight excess of this element should be taken. The crystalline fragments or layers are of a grayish, orange-red color, and when rubbed to powder give a deep, reddish, orange colored powder.

This powder, mixed with 3.5 parts of water, is much changed in appearance by the action of the water, and is but partially dissolved at 15° C.=59° F., even by prolonged shaking and digestion. When gradually warmed it dissolves more freely until at about 70° C.=158° F., all is dissolved excepting a small residue not soluble in any proportion of water, and which appears to be reduced arsenic. Upon allowing this solution to cool to 20° C. a very large proportion is deposited. When the powder is agitated with five parts of water at 20° C.=68° F. much more of it is dissolved, and in seven parts of water at this same temperature it is all dissolved excepting the small insoluble residue. The powder is only partly soluble in any proportion of officinal alcohol up to 1 in 30, at 20° C., and on standing the salt is evidently split by the alcohol as the liquid gradually becomes more iodine colored, and the undissolved portion

more grayish white. The solutions, both with water and alcohol, are of a pale yellow color, and the watery solution remains so for twenty-four hours, while the alcoholic solution standing on the undissolved portion becomes quite iodine-tinted in twenty-four hours.

When gradually heated on a platinum crucible cover the salt melts to a very dark reddish-brown liquid without giving off any vapors that are visible, but as the heat is increased, brown vapors are given off until the melted mass takes fire, and then violet vapors appear. If the flame of the burning be blown out, and a more cautious heating resumed, the brown and whitish vapors reappear and continue till the salt is all dissipated, with the exception of a scanty gray residue.

These are the reactions of a salt made from iodine and arsenic of good quality,—as good as can be obtained in the market,—but yet not chemically pure, and the salt was found to be slightly deficient in iodine. A portion of the salt rubbed to powder with a very small quantity of iodine added, gave practically the same solubilities, but gave solutions of slightly deeper color, and this salt on fusing gave faint iodine vapor, showing a very slight excess of this element.

These reactions were so very different from those prescribed by the Pharmacopœia, and the solubility being the test chiefly relied upon for the nature and purity of the substance, it was seen that there was some fault somewhere, and market specimens were obtained of three very prominent makers, one foreign and two domestic.

One of these was in crystalline form, from having been slowly cooled and then broken up. In solubility this specimen was sensibly about the same as that of the salt described, and it had about the same color, but the powder was of a deeper orange, and the solution was of a deeper color, though not iodine color. In melting, the faintest trace of violet vapor was perceptible at the moment of liquefaction, but afterward only the brown and whitish vapors until it took fire, when violet vapors were abundant as in the first case.

Another specimen was in hard crystalline lumps, with crystalline cleavage, and shiny faces, the cleavage surfaces almost the color of iodine, but duller and less violet; but other surfaces of the lumps had an orange-colored crust. When rubbed to powder, the powder was of a dark brown color,—not at all orange, but nearer to a dull iodine color. Perhaps about two-thirds of this powder was soluble

in 3.5 times its weight of water at 20° C., and it was, therefore, very much more soluble than either of the preceding specimens, and the solution was a very different one, being deeper in color than tincture of iodine, and of a similar tint. When either the lumps or powder were put upon paper, the paper was rapidly turned brown by the free iodine. When gently warmed on the crucible cover, iodine vapors escaped rapidly, and still more rapidly as the powder fused, and when fusion occurred, the liquid boiled with the escaping iodine vapor. Suddenly, then, the free iodine being all off, the brown vapors appeared, but in small proportion relatively to the quantity from the preceding specimens, and finally, at a red heat, a much larger residue remained.

The remaining specimen was very similar to the last in every respect, giving practically the same reactions.

It would appear from this that the specimen first described, although not agreeing at all with the requirements of the Pharmacopœia, is still really very nearly what the Pharmacopœia intends to have, a slight deficiency of iodine being the only discoverable defect. In the two last specimens, however, the iodine was in such great excess that the preparations were quite inadmissible, though largely sold and used.

Iodide of arsenic is of late years very rarely used in medicine, because its therapeutic action must be chiefly that of arsenic, and the dose is only about one-twelfth of a grain. The proportion of iodine in such a quantity is too small to be of any use. But as an element in the important officinal solution of Iodide of Arsenic and Mercury it is much used. This Donovan's solution, as it is often called, owes its value quite as much to the arsenic as to the mercury, and it will be easily seen how much it must vary in value as made from the specimens of iodide of arsenic above described. Specimens of the officinal solution were made up from each of the specimens for comparison, and few would suspect them as being the result of the same formula.

The solution made from the first specimen was of a very pale, greenish yellow tint, almost colorless, except when compared with distilled water. The residue left on the filter weighed a little less than 1 p.c. of the iodide taken, and contained some metallic arsenic, showing that the iodide was slightly deficient in iodine.

The solution made from the last described specimen was of a full deep brandy color. The residue left upon this filter weighed a little over 5 p.c. of the iodide taken, and had the appearance of fine

clay, with a few shining particles, but it was practically free from arsenic.

From the great excess of iodine present in this iodide, there must have been a corresponding deficiency of arsenic, and from this latter must be deducted the rather large proportion of insoluble impurities, so that, as a result, the highly colored solution could have had very little arsenic in it, while the very pale solution had within 1 p.c. of the full officinal proportion.

Upon standing for 24 hours, side by side in diffused daylight, the solution made from the first specimen showed no change of tint. But that made from the last specimen had lost its deep color, and was of the same tint as the first, showing that the free iodine had changed to hydriodic acid.

As it is not uncommon of late years to hear that Donovan's solution has failed of keeping up its former reputation, and that other preparations of arsenic are preferred, the question arises as to how much of its failure may be due to the quality of the iodide of arsenic used in its preparation.

ASAFŒTIDA.

ASAFETIDA.

A gum-resin obtained from the root of *Ferula Narthex* Boissier, and of *Ferula Scorodosma* Bentham et Hooker (Nat. Ord., *Umbelliferæ, Orthospermæ.*)

In irregular masses composed of whitish tears, which are embedded in a yellowish-gray or brownish-gray, sticky mass. The tears, when hard, break with a conchoidal fracture, showing a milk-white color, which changes gradually, on exposure, to pink, and finally to brown. It has a persistent, alliaceous odor, and a bitter, alliaceous, acrid taste; when triturated with water, it yields a milk white emulsion. It is partly soluble in ether, and at least 60 per cent. of it should dissolve in alcohol.

Preparations: Emplastrum Asafœtidæ. Mistura Asafœtidæ. Pilulæ Aloes et Asafœtidæ. Pilulæ Asafœtidæ. Pilulæ Galbani Compositæ. Tinctura Asafœtidæ.

This drug is an excellent illustration of the effect of trade interests upon many articles of the materia medica. Excepting occasional speculative movements and "corners" in the large markets it is always a very cheap article, and under the screw of price, and price competition first, and quality last, the range in price is even far greater than in quality. This range is from about ten to seventy-five cents per pound, and the common average, perhaps, from twelve to twenty cents.

In the London market it is often quoted at one shilling and four pence to three shillings per hundredweight. When it is remem-

bered that this drug is collected from the plants in quantities of two or three ounces at a time, then dried, and put up for transportation in Central Asia, then sent by river transportation many hundred miles to the Persian Gulf, or down the Indus to Bombay, and thence to the ports of Europe or this country, and that in this long freighting, not only the cost of transportation, but at least three profits have to be made off of it,—it will be seen that the collector can get very little for his time and labor.

It is not very wonderful, therefore, that in these markets it is never seen entirely free from other gum-resins, stones and dirt, and that these admixtures vary, perhaps, from five per cent. up to sixty per cent. It is fortunate, however, that the labor of intermixing the stones and dirt intimately is too great, and so they are simply surrounded with the juice when this is semi-liquid, and thrown into the cases. Hence, in most of the cases portions can be picked out which are comparatively pure,—or sufficiently so to answer to the above description and tests. It was formerly the general practice of pharmacists to pick out such portions of the masses, and then to select and detach from them the tears and the better matrix in which these are embedded, throwing the rest away. Such selections were then chilled by exposure in winter, or by ice in summer, and when cold were rubbed up into coarse powder and kept in a cool place, and from such material all the preparations were made. This excellent practice is not entirely abandoned yet, but it is very rare, and has chiefly gone out of vogue on account of the trouble it gave,—the disagreeable nature of the work,—and the abundance and cheapness of powdered asafetida.

Thus the therapeutic interest in the drug has been handed over to the tender mercy of the drug-miller and his trade interests.

Some drug-millers buy the drug and sell the powder, and sell it so cheaply that these supply a large part of the entire demand. But supposing the best practice to prevail, and see what that is. The wholesale druggist sends a case of asafetida to the mill to be powdered. The miller sees that his men pick out the stones that would break his mill, and possibly all the sticks and rubbish that come under prominent notice, and then the remainder goes into the special drying-room for this drug. Here it is melted and dried on steam trays until a large portion of the active part,—namely, the oil is driven off, and much of the remainder of it is oxidized by the air into resin. When a small portion taken out and cooled is brittle enough to grind, the whole is cooled and powdered,—and it must be so dried that it will not run or cake much in hot weather.

After such a process it is not wonderful that the powder, and the

preparations made from it, are not so disagreeable as to exclude them from the stores of the pharmacists, even of fashionable neighborhoods. Nor is it more wonderful that the powder and the preparations made from it are practically worthless; and the ultimate sequence of this condition of things is that asafetida has fallen into disuse, because it yields no definite results in use.

But there is another obstruction to the use of even bad asafetida. It still smells badly enough to be disagreeable to the sensual and fastidious classes of a high civilization, wherein hysteria is very prevalent in many forms, and the physician who should insist on treating his hysterical patients with either the Mixture or Tincture of either good or bad asafetida, would simply be discharged, and in all probability a homœopath would succeed him. The officinal Mixture of good asafetida, or the Tincture diluted with water,—probably comes as near to being a cure for a large proportion of cases of hysteria as any known remedy is to any known disorder, not only because it is a true stimulant anti-spasmodic of a high degree of efficacy,—but also because from the nature of many cases of hysteria the patients or subjects would have less and less frequent attacks, if in each attack a fluidrachm of Tincture of Asafetida in a wine glassful of water had to be taken every ten minutes until the attack was over. Powdered asafetida in coated pills will not relieve hysteria either by physical or moral effect,—nor will this powder in any form be of much use in flatulency. But pills made by the pharmacist or physician from well selected asafetida, as described and directed by the Pharmacopœia, are very efficient in the treatment of some forms of dyspepsia, and will relieve many cases of flatulence and flatulent colic very promptly.

ASCLEPIAS, or Pleurisy Root, is, to say the best for it, of very little use in modern medical practice, and its popular use in domestic practice might well be left unsupported by the Pharmacopœia. There is a good deal written about it, but this belongs chiefly to the indefinite part of the uncertain past.

There is no officinal preparation of it, and it does not occur in Dr. Bolles' account of the canvass of over 3,000 prescriptions in Boston.

ASPIDIUM, Felix Mas, or Male Fern. Peeled Male Fern Root has long been imported into this country from Germany, and is now so common, and can be had every year so fresh and of such good quality by those willing to pay a moderate price for it, that it has largely supplanted the entire rhizome and chaff as described by the

Pharmacopœia. The officinal direction to reject all the dead portions very properly restricts the use to the peeled root, and therefore this, as accessible in the markets, should have been described.

Peeled Male Fern Root occurs in the market in truncated curved pieces somewhat tapering from near the middle toward both ends, longitudinally wrinkled by unequal shrinkage in drying. The pieces vary in length from about ·75 inch or 2 centimetres to 2 inches or 5 centimetres, and in diameter from ·13 inch or ·3 centimetre to ·38 inch or 1 centimetre at the largest part. The color is tawny brown externally, and should be fairly uniform in any unmixed parcel. The external color is of a lighter or darker tawny brown in proportion to the freshness or staleness of the root, and in very fresh or recently dried root the light tawny brown has a greenish tint, because when freshly peeled for drying it is of a pale green color, which changes to brown during the drying, and becomes browner as the root is longer kept. The pieces break with a snap, and when fresh and good are of a pale green internally. This internal green color by its depth of tint, and by its extent of tint, closely indicates the freshness and good quality of the root. When recently and properly dried the pale green has little of the yellow or brown tint, and extends out to the very surface of each piece, and is similar in every piece that is broken. As the root is kept, the tint toward the surface becomes yellower and browner, so that when it has been well kept for a year, the fracture is greenest at the centre, shading outward to yellowish and brownish green. When much over a year kept, or when over dried, the green fracture gradually disappears, giving place to a browner fracture, deepest toward the centre, until finally all tinge of green disappears. In a specimen well kept during seven years, and examined at this writing, every piece of which was originally green throughout,—there was not a tinge of green remaining, the centres being of a richer, deeper brown than the surfaces, and the surfaces much browner than in a recent specimen.

When, on examining a parcel for purchase, every root breaks green and with a uniform tint throughout the fracture, the parcel is fresh and of good quality. When the green tint is deepest in the centre and shades off to brown at the surface, it is less fresh, and may be a year old or more, but is still of fair quality. If the external color be not uniform, and if in fracturing 20 pieces or more, some are met with having a brown fracture, while others are green, the indication is that old stock has been mixed with the new,—a condition by no means uncommon.

This drug is the source from which the officinal oleoresin is

made, and in that preparation all the landmarks of quality are gone, and it is impossible to tell whether it be made from the unpeeled or peeled root,—or from fresh or partly fresh, or stale root. Its only use is to expel tape-worm, and its success or failure, when properly used, doubtless often depends on the quality of the drug from which the oleoresin is made. Hence, if there be a doubt of the oleoresin, it may be well to use the drug in substance, as was done when Frederick the Great bought the secret of its use from Daniel Mathieu, and when later Louis XIV. bought the same secret from Madame Nuffler. It is not difficult to administer in powder suspended in water or syrup,—or in emulsion, though the dose is large,—300 to 600 grains in divided doses, equal to 25 to 50 grains or minims of the oleoresin.

ATROPINA.

ATROPINE.

[ATROPIA, *Pharm.*, 1870.]

$C_{17}H_{23}NO_3$; 289. — $C_{34}H_{23}NO_6$; 289.

An alkaloid prepared from Belladonna.

Colorless, or white, acicular crystals, permanent in the air, odorless, having a bitter and acrid taste, and an alkaline reaction. Soluble in 600 parts of water at 15° C. (59° F.), and in 35 parts of boiling water; very soluble in alcohol; also soluble in 3 parts of chloroform and in 60 parts of ether. When heated to 114° C. (237.2° F.), the crystals melt, and, on ignition, are completely dissipated, emitting acrid vapors. Atropine and its salts are decomposed and rendered inert by prolonged contact with potassa or soda, and, if heated with either of them, evolve vapor of ammonia.

With sulphuric acid Atropine yields a colorless solution, which is neither colored by nitric acid (abs. of and difference from morphine), nor at once by solution of bichromate of potassium (abs. of and difference from strychnine), though the latter reagent, by prolonged contact, causes the solution to turn green. On heating this green solution, diluted with a little water, to boiling, a pleasant odor, recalling that of roses and orange flowers, is developed. The aqueous solution of Atropine, or of any of its salts, is not precipitated by test-solution of platinic chloride (difference from most other alkaloids). With chloride of gold it yields a precipitate which, when recrystallized from boiling water acidulated with hydrochloric acid, is deposited on cooling (rendering the liquid turbid), in minute crystals, forming a dull, lustreless powder on drying (difference from hyoscyamine).

So far as known to the writer, neither Atropine nor its salts are made in this country; but all are imported, and generally from one or two makers. Some manufacturers here who have them on their lists, import them in bulk and put them up under their own label, while the wholesale druggists import them put up, and sell them under the foreign maker's label. There are several reasons why

such alkaloids and their salts are not made in this country, and the chief of these is the enormous duty upon alcohol, which precludes its use as a general solvent in manufacturing processes,—or makes it so expensive, that other nations having no such tax, can supply the products of its use at so much lower cost, that even with a high rate of import duty they cannot be made here at a profit sufficiently attractive to capitalists. With alcohol untaxed, other obstructions, such as cheaper material and cheaper labor, might, perhaps, be overcome.

It is therefore to imported Atropine, and chiefly from one source, that the above description and tests must apply in controlling the uses in this country, and although this description and tests appear to be very full, they are really not discriminative against adulteration, nor very accurate so far as they go. The chief and characteristic tests are the solubility and melting point, and both these are very difficult to apply with accuracy. If very finely powdered atropine be mixed with 600 parts of water at 15° C., and great care be taken to keep that temperature constant, with occasional shaking, some undissolved particles will be visible with a glass after two days. But if the temperature be allowed to rise even a degree or two, the solubility is greatly increased. At an ordinary room temperature of 20° C., 1 part is soluble in 250 parts of water. One part in 150 of water warmed to about 35° C. is entirely dissolved. At 55° C.. 1 part in 100 is entirely soluble. One part in 35 is not entirely soluble at the boiling point of the solution, but very nearly all is dissolved. But all these solutions may be cooled down to 0° C., even with the addition of a crystal of the alkaloid without any deposit, or any change in the perfect transparency of the solution, or any perceptible growth in the crystal added within 24 hours. These results were obtained repeatedly both from the alkaloid as imported, and after precipitation from the sulphate. Therefore, although the alkaloid is in one restricted sense soluble in 600 parts of water at 15° C., it is still easily practicable to make a permanent solution which at the same temperature holds 1 part in 50 of water.

When heated with water by means of a bath of boiling water the crystals melt much below the boiling point of water, but when heated alone in a bath of glycerin the crystals begin to melt at about 104° C., and are entirely melted at about 113° C., although the melting point as given on the label of the bottle is 115° C.

The tests which distinguish between atropine and morphine and strychnine are not important, because it is not liable to admixture with these, and therefore these tests were not applied,—nor that to detect hyoscyamine, as this is a much more costly alkaloid.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. MAY, 1885. No. 9.

HYDROCHLORATE OF COCAINE.

A few months of additional experience with the process given for this salt at page 717 has developed some improvements in the details of the process which are worth adding, because they overcome some of the difficulties mentioned as incidental to the process as there given.

The new process for the extraction of the cinchona alkaloids by the use of kerosene was tried, but its inferior capacity as a solvent for cocaine, and some other disadvantages seemed to overbalance its cheapness in comparison with alcohol and ether, unless the scale of operations was much larger than is likely to be required in the case of cocaine. If cocaine was to be used in the near future in one-thousandth part the quantity of the cinchona alkaloids the much larger special apparatus required for the use of kerosene would doubtless be justified. But so long as the uses of cocaine are as limited as they are likely to be, alcohol and ether appear to the writer to be the best solvents so far, and hardly anything better can be imagined if alcohol and ether were once freed from the enormous spirit tax. Another point against the kerosene process in the writer's hands is, doubtless, that he don't know how to use it properly, whilst the one given at page 717 is now so satisfactory.

The first improvement made in the writer's process was to have the coca in much finer powder than was at first used. It is a difficult substance to exhaust thoroughly, and there is much difficulty in knowing when it is exhausted. Larger and larger yields were obtained as the powder was made finer and more menstruum used, until the maximum seems to have been reached with a powder through a sieve of 60 meshes to the linear inch instead of 20, and

menstruum to the amount of 6 times the weight of the powder instead of 5 times, and this when the great advantage is taken of repercolation.

The small proportion of about one part acid in 583 parts of the first portion of the menstruum or ·17 p.c. still seems to be a great advantage to the process, but there is no apparent advantage in reducing the proportion below this. And hydrochloric acid s.g. 1.16, in double quantity may be substituted for sulphuric acid.

When all the alcohol has been distilled off, it is a very considerable improvement to add to the extract, while hot, about one-tenth of the weight of the coca represented in the extract, of water containing about 2 p.c. of acid. This is transferred to one or more bottles, which are only half filled, and when the liquid and apparatus are cold, the still is rinsed clean with two or three applications of ether in small quantities, the ethereal solution or washings being added to the contents of the bottles. Instead of attempting to wash the salt of the alkaloid out of this clotted mass of resinous extractive by water, which is very difficult to do, stronger ether is added to the mixture to the amount of about one-twentieth of the weight of the coca represented in the process. This at once dissolves all the chlorophyl and resinous extractive, and allows the acidulated water to be brought in better contact for the washing out of the alkaloid salt, which is insoluble in ether. The watery solution is then separated, and the ethereal residue is washed twice with fresh portions of the weak acid in small quantity, the washings being added to the first watery solution. The ethereal extractive is then free from alkaloid, and is set aside until the ether can be recovered from it by distillation. Next, the watery solution is washed three or more times with small quantities of ether, until the ether, after vigorous shaking and separation, comes off nearly colorless. These ether washings are then added to the ethereal extractive from which the ether is to be recovered by distillation.

Next, a fresh portion of ether, equal to about 3 p.c. of the coca represented, is added to the watery solution, and then a considerable excess of crystals of carbonate of sodium,—say, about ·75 p.c. of the coca represented, and the whole is well agitated. This precipitates the alkaloid from the watery solution and the alkaloid is then dissolved at once in the ether by the agitation. When the liquids separate, a few crystals of carbonate of sodium are added to ascertain whether the precipitation be complete. If these cause a precipitate in the lower watery solution, more of the sodium

salt is added with fresh agitation, until the last additions cause no cloudiness. The liquids are then separated, and the watery solution is washed once by active agitation with a small quantity of fresh ether, and the ether being separated and added to the larger portion, the watery solution, now practically exhausted of alkaloid, is thrown away.

The ether now holds the free alkaloid and some coloring matter in solution, and the next step is to saturate this alkaloid with acid and wash it out of the ether as a salt insoluble in ether. This is done by agitation with a small quantity of water containing about 10 p.c. of hydrochloric acid.

This time the acid should not be in great excess, and therefore several washings are made with small quantities of the weak acid, until the last one gives no cloudiness with carbonate of sodium solution. The ether, now practically free from alkaloid, is added to the other ether residues to be recovered by distillation. The watery solution of crude hydrochlorate of cocaine is then slowly percolated through the purified bone-black, the proportion of black being about ·5 p.c. of the coca represented. The solution should come through the black of a very pale, greenish yellow color. It is then again precipitated by carbonate of sodium in excess in the presence of ether, when it yields a pale yellow ethereal solution of the free alkaloid. This is separated, and held in a stoppered, globular separatory funnel of large size, and is now ready for the separation of the yellow matter which has been supposed to be another alkaloid of coca, and called hygrine.

If the coca represented in the process be about 45 kilos, or 100 pounds, about 5 c.c. or 80 minims of strong hydrochloric acid, s.g. 1.16 is dropped into the ethereal solution and thoroughly shaken with it. A very dense yellow solution of hydrochlorate will then separate, leaving the ethereal solution nearly or quite colorless. The dense solution of hydrochlorate is drawn off, and if the ethereal solution be not sufficiently free from the yellow tint, another smaller portion of acid is dropped in, well shaken, and separated as before. If the previous management has been skillful, one, or at most two portions of acid will leave the ether solution sufficiently decolorized, —that is, of a very pale, greenish yellow tint.

The remainder of the alkaloid in the ether is now almost absolutely pure, and it is to be exactly saturated by careful additions of a somewhat more dilute acid with careful testing by litmus paper of each solution drawn off. The final solution drawn off will nec-

essarily be acid if the ether be washed clean, and this is not to be added to the other portions which are neutral,—but is reserved for the next process. The portions which come off neutral are of a yellow tint, but they yield a nearly white salt. They are evaporated together at a low temperature with almost constant stirring until they cease to lose weight, and the salt is then powdered and passed through a sieve of about 60 meshes to the inch.

The very dense and very yellow portions are reserved until they accumulate from several processes. They are then diluted with water to about ten times their volume, and the solution is passed through a fresh portion of bone-black, and treated exactly as the original solution was.

Each separate lot of, say, 600 to 800 pounds of coca is conveniently divided into 6 or 8 processes of 100 pounds each,—or 3 or 4 processes of 200 pounds each, and the residues from them are then economically worked up together at the end, and thus the yield of each lot is pretty accurately obtained.

Two such lots of the inferior brown leaves, which quality only has been accessible in this market in any considerable quantity, for many months past, when worked up by this modified process, yielded,—the one ·19 p.c. and the other ·23 p.c. That is, the first yielded over 13 grains, and the second 16 grains of the hydrochlorate of cocaine to the pound of the inferior coca.

The Assay Process.

This process has been modified in application from that given at page 726, exactly in accordance with the manufacturing process just given.

As this method of assay is applicable to many of the alkaloids, and will therefore be referred to hereafter, and is both convenient and easy, it is worth while to give it in detail as now modified. It does not pretend to great accuracy, and is therefore not adapted to the use of the few scientific chemists, but in common with other processes, and other work, given in these pages, is useful to the many pharmacists and manufacturers who are satisfied with moderately close approximations of the strength and value of the materials which they use.

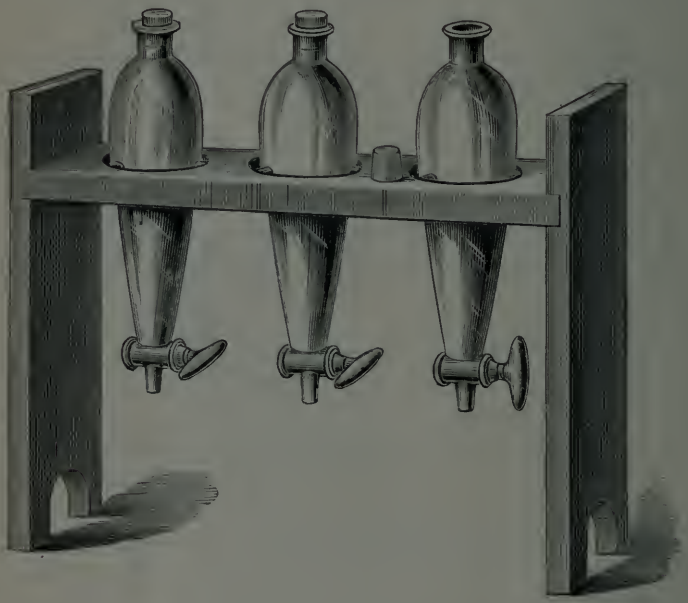
The method is applicable to all alkaloids which are soluble in liquids not miscible with water, or soluble in water to any great extent, and which do not themselves take up much water ;—and which do not dissolve the salts of the alkaloids. For example,

ether, chloroform, amylic alcohol, benzene, carbon disulphide, kerosene, etc., each dissolve certain alkaloids when in the free state, but yield them up when combined with an acid. That is, the alkaloids are freely soluble in these liquids, but the salts of these same alkaloids are insoluble. Therefore, if the liquids hold free alkaloids, these can be washed out of them by acidulated water, if the acid of the water combines with the alkaloid to form a salt soluble in water.

Then again, watery solutions of salts of the alkaloids can be washed free from these alkaloids, by means of these liquids, by the addition to the mixture of an alkaline precipitant which, by combining with the acid of the salt, sets the alkaloid free in the presence of the solvent liquid. The washing out is done by active agitation, after which the two liquids are allowed to separate as completely as possible, and the heavier liquid is then drawn off from the lighter one. As all the solvent liquids used dissolve a little water, and water in its turn dissolves a little of the liquid, repeated washings and separations become necessary, since that portion of the solvent liquid dissolved by the water, and that portion of the water dissolved by the liquid, each hold a small proportion of alkaloid.

To carry on these repeated washings and separation of liquids rapidly, and with a fair degree of accuracy and convenience, a separating apparatus of some kind is essential, and the writer some years ago combined the shaking flask with the separating funnel with very great advantage to this and many other processes. An illustration of these separators in an appropriate stand, is here given and will be understood without description. Two of these are generally needed and it is often convenient to have three, as shown in the cut, drawing the heavier liquid from one directly into the other backward and forward as the washings proceed. The cut shows the apparatus of one-fourth the linear dimensions, each separator being of about 200 c.c., or nearly seven fluidounces total capacity, and capable of shaking a mixture measuring from 100 to 150 c.c. The stop-cocks should be so carefully ground as not to leak water upon standing full overnight, and should be kept lubricated with a very minute quantity of soft paraffin.

With some such conveniences the method is very simple and easy of application, as it entirely avoids troublesome filtrations, and the chief difficulty is in washing the liquids clean, especially when they are loaded with extractive matter, or with salts of the alkaloid used for precipitation. The final evaporation of volatile liquid leaving the alkaloid to be weighed, is not difficult if done in



SEPARATORS.

FOR THE EXTRACTION OF ALKALOIDS.

ONE-FOURTH OF THE ACTUAL SIZE.

a beaker or other straight sided vessel to prevent creeping, and the [redacted] remains to be weighed as alkaloid, does [redacted]loid which escapes the washing out

ı fine powder is moistened with 40
o which has been added ·08 gramme
3, or ·16 gramme of hydrochloric
ercolator, and if there be no haste,
It is then percolated with strong
l exhausted, or until the percolate
es the weight of the powder. The
ow temperature until free from alco-
into a separator by the successive
· until about 25 to 30 c.c. of each
e whole of the extract transferred.
ıcid is added, and the whole is vigor-
'e forms an emulsion which does not
o, a farther addition of acid, and a
a more prompt separation. The
n off into another separator, and the
) c.c. of acidulated water, this wash-
solution, and the ether residue being
ution is next washed with successive
c.c. each, until the ether remains
are separated from one separator to

ıd an excess of crystals of carbonate
ıw off the watery solution into the
al solution into a small tared beaker.
10 c.c. of fresh ether and add this
aker. The beaker then contains
kaloid in ethereal solution. By set-
alkaloid is soon left in a crystalline
pon the bottom and sides of the beak-
o longer loses weight. The weight

is then taken, and this may generally be accepted as the proportion of crude alkaloid. If the crystals be rinsed off twice with 5 c.c. of distilled water each time, and be then again dried and weighed, the assay will be closer. If the alkaloid be left in the varnish-like condition, the washing with water will cause it to crystallize, after rinsing the water round the beaker for a time without a stirrer. The

crystals should then be entirely but slowly soluble in 10 c.c. of very dilute acid, and the solution should give a strong impression upon the tongue characteristic of cocaine. The result appears to be a very close approximation to what the coca yields, but it does not yield as much to the manufacturing process by about 10 p.c., chiefly on account of the loss in the bone-black, and by splitting up.

A sample of Bolivian coca recently received yielded by this assay process ·55 p.c. of alkaloid. This, however, was exceptionally fine coca, and if such could be obtained in quantity it would doubtless yield ·5 p.c. of the hydrochlorate, or say 35 grains to the pound.

A sample from a lot of about 3,000 pounds recently received gave ·5 p.c.

COCA AT THE SOURCE OF SUPPLY.

Very soon after the effects of cocaine on the mucous membranes were established beyond reasonable doubt, and the scarcity of good coca, from which to make the alkaloid, was realized, Dr. F. M. Gunnell, the Surgeon-General of the Navy, took an active interest in the subject of the supplies of coca, and the causes of the scarcity, and the inferior quality as received in this country. Having written to the medical officers of the Navy on duty along the western coast of South America, he took the subject to the Hon. W. E. Chandler, Secretary of the Navy. Secretary Chandler addressed the State Department on the subject, and about the middle of January the Hon. F. T. Frelinghuysen, Secretary of State, addressed a circular letter to the Diplomatic and Consular Officers of the United States in Peru, Bolivia and Chili, "in regard to the difficulty of procuring coca for the United States of a reliable quality, and inquiring where the best varieties of coca are found, and the best mode of preparing it for transportation, and how it can be brought within reach of the American purchaser."

Medical Director L. J. Williams, of the Navy,—himself personally familiar with the western coast of South America,—had some good correspondents there to whom he wrote on the subject; and finally the writer corresponded with several intelligent gentlemen more or less familiar with coca at its source of supply.

The writer is very much obliged to Dr. Gunnell not only for his own efforts in the matter, and their importance, and for copies of his correspondence, but also because through him was obtained all

the information from the correspondence of the Department of State. The writer is also very much indebted to the Hon. Richard Gibbs, U. S. Minister to Bolivia, for some years resident at La Paz; and to the Hon. S. L. Phelps, U. S. Minister to Peru, who has for some years been located at Lima. Each of these gentlemen favored the writer with private letters on the subject, as did also Consul F. W. L. Dauelsberg, of Arica and Mollendo. Dr. Wm. H. Jones, of the Navy, also supplies much useful and important information.

The writer has long had a very intelligent correspondent at Pará, Brazil, and knowing that the tributaries of the Amazon ran through fertile coca districts of both Bolivia and Peru, he supposed that a commerce in the article might be started down the Amazon, thus avoiding the transportation across the Andes to the western coast. An opportunity occurred of meeting this correspondent, Mr. Wm. Brambeer, of Pará, on his way home. He was shown the article, which he had never seen at Pará, and was instructed in points of identity and quality, and took with him a sample of Bolivian coca of fair quality; and in less than three months' time the writer received from him a shipment of coca which came down the Amazon to Pará.*

From all these sources the following information is compiled; and the information is believed to be more complete, more recent, and perhaps more trustworthy than any hitherto published.

The most elaborate and most complete of all the communications on the subject is the report of U. S. Minister Gibbs, of La Paz, to the Department of State. La Paz is the great centre of the coca trade of Bolivia, and the business in it there is very large, the Gov-

* This shipment, however, turned out badly. The leaves were evidently a very good variety of wild Peruvian coca, just what they purported to be, and there was no discoverable admixture of other leaves. But when the bales were opened the leaves were found to be damp and mouldy, and with neither the odor nor taste of coca. Although put up in three thicknesses of bagging, and one clumsily applied covering of tarred cloth, they had evidently become damp and heated during transportation. Upon assay these leaves, although looking pretty well, yielded a very small proportion of alkaloid, and were not worth working. The whole cause of this great sacrifice of an originally good article, was in the very bad way in which they were put up for transportation. Had they been put, when quite dry, in metal lined boxes and soldered up, they would have been worth $1.30 per pound on their arrival, and even in ordinary times would have brought half that price. Any such price as 65c. would have yielded a profit of say 20 p.c. to the shipper. It is very much to be hoped that such results will lead to better packing.

ernment deriving a very large revenue from the tax upon the coca. There are many large dealers there, and Mr. Gibbs gives the name of Messrs. V. Farfan & Co., as one of the best and most important, as it is one of the largest commercial houses of Bolivia dealing in coca. This house has four large plantations in as many yungas,—or deep narrow valleys in the sierras or mountains. Mr. Gibbs states that much of his information was obtained from this firm.

There appear to be two very distinct varieties of coca,—the Peruvian and Bolivian, each country claiming each variety as being the best. Peruvian coca is a smaller, narrower leaf, and so much thinner and more fragile in texture that it is much more broken in gathering, drying and packing. It is of a much brighter green color when in best condition, and by age and change during transportation it becomes of a duller, lighter, yellowish green, while the Bolivian becomes yellowish brown or brown. The Bolivian is the larger, broader, rounder, thicker and stronger leaf, less broken up, and when in its best condition is of a dull, deep olive green on the upper side, and much lighter beneath. The characteristic faint lines on the under side of the leaf, which form a narrow ellipse with sharp ends, (lanceolate) the midrib passing through the centre,—are more faint and more frequently undistinguishable in the Peruvian than the Bolivian variety,—or rather, the lines are seen on every leaf of good Bolivian coca, but are not discoverable in a small proportion of the Peruvian leaves, even when unadulterated. The odor and taste of the two varieties are almost identical, but differ much with the quality.

In both the quality is uniform throughout each package, and is good or bad, not so much from the original character of the leaf, as from the damage in curing and transportation. These two varieties, of course, shade off into each other, as the districts from which they come lie nearer to each other, so that it is often difficult or impossible to tell whether certain parcels are Peruvian or Bolivian.

Each variety is subdivided into the wild and cultivated leaf. Coca from wild plants is larger and thinner, and is generally considered inferior, but of its inferiority there is much doubt. It reaches the markets more broken, and less carefully put up, and this may cause a prejudice against it. If in good condition it yields about the same proportion of alkaloid as the cultivated coca, but as there is undoubtedly a value to coca which is not measured by the yield of alkaloid, the proportion of alkaloid does not disprove the alleged inferiority.

The general method of cultivation seems to be common to Peru and Bolivia. The best coca is said to be produced on hill sides which are from 3,000 to 6,000 feet above the sea-level, and it is grown upon terraces of various widths on the sides of deep narrow valleys called "yungas." The seed is sown during August in beds, or boxes filled with earth, and by the following June, when the plants are 8 or 10 inches high, they are transplanted on the terraces about three feet apart, in a soil kept free from shade and from any other growths. By November the first or lower leaves are of the deep olive green color which marks maturity. A rich soil is needed, but fertilizers are not used, and, however good the soil, it is said to be rather rapidly exhausted by the plants, so that a succession of fresh plantings is kept up. The shrub grows to the height of from 2 to 6 feet, but the largest plants do not yield the best leaves. Each bush yields, as a rule, three crops a year,—or in exceptional localities four crops. The first is called the March crop, the gathering commencing in January. The second is the Saint John crop, beginning in May, and the third is All Saints, collected in October, and then the shrub is completely stripped of leaves. Moist seasons produce the most delicate leaves of finest quality, and droughts are very destructive to the crops, but as droughts in these mountains do not extend over very large districts, the total crop is not often seriously varied from this cause. The crops are gathered leaf by leaf, chiefly by Indian women and children, who stoop in front of each bush and collect only the leaves which are mature, in their aprons. Minister Gibbs' authority tells him that the women are careful not to touch the top of the bush, for, if this be touched by man or animal, "it withers and dries up." Men visit the women from time to time, and take the gathered leaves, in large sacks, to an enclosed yard, which is paved with smooth flat stones or slates, laid with very close joints and kept very clean. These pavements are so situated as to get the full force of the sunshine, and the first gathering of leaves is not brought to them until they are very hot from the sun's rays. The leaves are then spread thinly over the hot pavements, and being loosely raked and turned from time to time, are dry in from 3 to 4 hours in favorable weather. Sometimes, however, they have to be left overnight, and are then liable to be damaged by dew. No gathering is done in very cloudy or damp weather, and damage only occurs from changes during the day after the collection has begun. When dry, the leaves are packed at once by means of a rude wooden press in

square bales, of coarse cloth, of a cesta, or about 25 pounds each. Two of such bales are put together under another envelope, generally made from the bark of the banana tree, and such a package of about 50 pounds is called a tambor, or drum, and measures about 11x15x17 inches. When these parcels have to be sent across the coast range of mountains for exportation, three are put together in a tarpaulin-covered package of 150 pounds, and two of such packages make a load for a mule or other pack animal for this transportation of several hundred miles through mountain passes. Coca is very easily damaged by the combined effect of heat and moisture, and is, therefore, always stored in cool, dry warehouses, and rarely handled or transported in damp weather or during the rainy season. This rainy season is from January to April, and, therefore, that stored on the west side of the coast range is alone available for export during the rainy season. When exported it is said that it usually starts in very good condition, and will reach its destination in the same condition, if carried in a cool, dry place. Such transportation is always stipulated for in bills of lading, but the proper precautions are generally neglected, and hence the worthless condition in which it is often seen. The only absolute security for it in transit is, therefore, to have it soldered up in tin or zinc, enclosed in wood, and such parcels generally contain two tambores, or about a Spanish quintal of 100 pounds. Although shipped from many ports along the whole coast, the principal port in Peru seems to be Salaverry, the port of entry of Trujillo or Truxillo, and the principal port for Bolivia is Arica,—Mollendo being now closed by the civil war in Peru.

Much of the difficulty in getting good coca during the past year or two is attributed by all the correspondence to the demoralization incident to the civil war.

Coca seems to be produced throughout the whole Andean plateau from Equador to the Argentine Republic. The Peruvian government is said to record and tax a production of over 15,000,000 pounds per annum, and the Bolivian government about 7,500,000 pounds. Of the latter quantity, Mr. Gibbs says, about 55 p.c. is consumed in Bolivia ;—Argentine Republic and Chili, each 15 p.c., and Peru, 10 p.c., while the remaining 5 p.c. is exported to the United States and Europe; thus giving about 375,000 pounds as the export of Bolivia. As Peru produces about double the quantity credited to Bolivia, it seems probable that about double the quantity may be exported, or, say, 750,000 pounds; and if this, too,

goes to the United States and Europe it would make an aggregate of about 1,125,000 pounds.

The market report here is that one manufacturer of cocaine in Europe, and one here have each secured this entire crop for this year, and a third manufacturer has secured "the remainder." If these reports be true in the aggregate, cocaine will be very plentiful, since 1,000,000 pounds of coca would yield at least 2,500 pounds of cocaine, while one-fourth of that quantity would probably overstock the whole world.

Mr. Phelps gives some important statistics in regard to cost price. His data are obtained from the owner of a hacienda, or coca plantation. This hacienda of Señor Don Carlos A. Gonzales Orbegoso, of Lima, Peru, lies northeast of Lima, is about thirty leagues in extent, and yields about as good coca as is to be found. On the estate it is sold in packages of about 14 ounces, each at 2½ to 3 reals. The cost at Trujillo would be about 35 sols of silver per Spanish quintal of 100 pounds. The cost of tins and packing, and of transportation to the seaport, Salaverry, would be about 6 sols additional, —total, 41 sols, equivalent in bills on New York to $31.75 per Spanish quintal of 100 pounds, or, say, 32 cents per pound on shipboard, with freight to New York at about $1.50 per cubic foot. But the owner qualifies this estimate by saying that any unusual demand might put up the price.

Minister Gibbs says the price in Bolivia varies with the supply and demand of different years from 1875 to 1884, between 8 and 20 "soft dollars" per cesto. The "soft dollar" is stated to be equivalent to 80 cents, and the cesta or cesto is about 25 pounds, so that the extremes of price seem to be about 26 to 64 cents per pound,—and this, by inference, at the seaports of Arica or Mollendo, the shipping charges and freight still to be added. It is retailed to the consumers by the small shops and on the sidewalks, from the original packages or cestas, at the rate of about 5 cents for 21 or 22 grammes, or ¾ of an avoirdupois ounce, or about $1.00 per pound—or by the single pound at about 80c.

The consumers of coca both in Peru and Bolivia are the native races, and among these the consumption seems to be a nearly universal habit, and this habit must have descended from the times of the Incas, since Mr. Gibbs says he has found buried with the ancient Peruvians small quantities of coca and the small earthen vase used with it to hold the lime or potassa of the coca-chewer.

The whites of these countries seldom use coca except as an infusion, and then the first water is thrown away as being too strong.

Mr. Gibbs is informed that habitual consumers of coca know nothing of toothache, and have their teeth in good condition to the greatest ages attained.

The habit seems to be not unlike that of chewing tobacco, and the effect obtained from it,—or supposed to be obtained,—is of a similar kind, although it is doubtless a restorative or gentle nervous stimulant, rather than a narcotic.

There is no allusion in any of this voluminous correspondence to any advance in prices, due to the late excitement and demand, either in Peru or Bolivia, and it is therefore probable that the enormous advance in prices here and in Europe has yielded enormous profits to the holders, while the supply at these high prices, in the New York market, has been abundant, though the quality has been very low.

Looking back over the past six months in the light of all the transactions of the market the writer now believes the scarcity in this market to have been a fictitious one, maintained solely in the interests of price and profit. And the reasons why a fictitious scarcity could be maintained so long were, first, that the holders were very few in number, and could control all arrivals, while the demand was very sharp and greatly beyond the real necessities of the case. Next, because the excitement in the market came at a time between the October and March crops, and during the rainy season, when but little coca could safely cross the coast range to the seaports. And finally, by the civil war among a people who, at best, are very slow to respond to the demands of trade, though very greedy of gain, and always impecunious.

The great danger now seems to be that all this will produce a corresponding reaction. The writer has not known the time when a ton or two of coca of inferior quality, yielding fairly of alkaloid to the improving process, could not have been easily bought in this market, but at very high prices,—say, from $1.25 to $1.75 per pound, while for two months past the arrivals have not been large enough to make much impression on the price. The March crop is now gathered and in the home markets, and if, stimulated by the reports of the high prices here and in Europe, large quantities are thrown into these markets, the price may be ruinously depressed.

No one seems to think how small a quantity of the alkaloid will really be required for all the uses to which it can be put,—or how far a drachm vial of a 4 p.c. solution really goes in the ordinary practice of any physician or surgeon. It is now highly probable

that every manufacturer in this country is, in common with this writer, overstocked with alkaloid, and wishing that he could find a sale for it that would enable him to make it on a larger and therefore, more economical scale. The writer has assayed samples of good coca sent by Dr. Jones, Mr. Gibbs and Mr. Dauelsberg, and they all yielded over ·35 p.c. of cocaine, or about 25 grains to the pound. Assays of two lots, which arrived during the past month, gave each about ·4 p.c. equivalent to about 28 grains to the pound. But thus far all these lots are controlled in the interests of high prices, none that was good having been met with at less than $1.00 per pound. From such coca, at a moderate price, the salt of the alkaloid could be sold at a fair profit at 15c. per grain instead of the recent price of 30c., and any one of the four manufacturers in this country could easily supply the entire demand.

Late in April, however, the price of the hydrochlorate, though pretty firmly held in the wholesale market, was reported to have declined in private channels. The Medical Department of the Army was in the market for 2,000 grains, and although the quantity was so small, the competing bids were said to be 18, 19, 19½, 20 and 22 cents per grain, and this report, if not entirely correct, was believed to be very nearly so. This gave the writer another opportunity of reducing his price without risk of being bought out for competition. He had been selling at 30c. per grain, subject to the 10 p.c. discount of his list, and had not varied from that price. But when others were offering at 18c., he also reduced his price to that figure on May 20th, that is, to 20c. per grain, subject to 10 p.c. discount upon the conditions of his list of prices. This price is quite high enough now that coca of fair quality is coming in so freely that the high prices cannot be longer maintained.

The quality is improving very much with the quantity arriving, and soon, upon the arrival of that shipped in tins, there will be an opportunity of making a good fluid extract again.

PRESERVATION OF SOLUTIONS OF HYDROCHLORATE OF COCAINE.

In the use of the solutions of hydrochlorate of cocaine the experience of some careful observers has led to the belief that even the minute proportion of salicylic acid used to protect the solutions against visible growths which destroy the alkaloid, adds to the primary

irritation of the solutions. The same solutions protected by boric acid, used by the same observers, were judged to be less irritant, and were preferred. Such preference was justified by the well-known fact that while stronger solutions of salicylic acid are irritant to delicate and diseased tissues, those of boric acid are known to be sedative and are constantly used therapeutically as sedatives.

But salicylic acid in the proportion of one six-hundredth had been used for the protection of solutions of the alkaloids so long that it was known to be effective, while boric acid had not been as well tried, and before a change could be made with safety to the solutions, the two substances had to be submitted to parallel observations, on trial.

In November last these trials were begun with boric acid, and a proportion of ·5 p.c. in the solutions was adopted as being probably sufficient, while entirely free from irritation. Ophthalmologists had long used simple solutions of boric acid in water, in the proportion of 5 to 10 grains in the fluidounce, to allay irritation, and the proportion adopted for protection was less than half this strength. Therefore, if it should not prove protective there was room to double the strength without danger of irritation.

During November and December it was found that solutions made with distilled water and filtered in the ordinary way, whether protected by the one or the other agent, kept well for six weeks; but it was also found that 3 out of 5 vials of the same solution unprotected, also kept well for the same length of time, while 2 out of the 5 contained visible growths.

On January 25th, solutions made in the ordinary way, both protected and unprotected, were put in a warm place exposed to a strong diffused light, and the vials were left uncorked for four days, and then corked. During this exposure, uncorked, many particles of dust got into the vials, and about one-fourth of the water evaporated off. At the end of 3½ months one out of two unprotected vials contained slight vegetable growths visible to the naked eye. The other unprotected vial, and two pairs of protected vials were apparently unchanged.

On February 13th, another set of vials were started. In two months vegetable growths were visible in both unprotected vials, but in very small quantity, requiring a lens to distinguish them from the dust particles. The protected vials were to all appearance unchanged, at the end of three months, in a temperature varying between 70° and 80° F., with full exposure to light.

On March 2d, duplicate sets were prepared, each set consisting of No. 1, a vial of the distilled water from which the solutions were made.

No. 2. Ordinary solutions made about February 21, one vial protected with each agent,—a vial of each.

No. 3. Similar solutions, freshly made,—a vial of each.

No. 4. Solutions freshly made, but unprotected,—two vials.

One set of these vials was put in the same warm, light place by a steam radiator, in an office room, and the vials were left uncorked during ten days, and were then corked, fully half the water having evaporated when they were corked. By the end of one month a beautiful vegetable growth had commenced in one of the vials of unprotected solution, but none in the other. At the end of two months the growth had increased in the first mentioned vial to about half the diameter of the vial below the surface of the liquid, and upon the surface there appeared a little heap of black grains in the centre, with scattered grains around the heap. At this time, too, a similar growth was just visibly commencing in the second unprotected vial.

All the other vials appeared to be unchanged excepting for particles of dust which had settled in them while open. The liquid was quite transparent and bright in all.

The duplicate set of vials were sent to Drs. Arthur Matthewson and Wm. H. Bates, the latter having kindly volunteered to place them under microscopic observation. The writer is very much obliged to these gentlemen for a report upon the subject from which the following summary is given.

The vials were kept in an incubator at a temperature of 98° to 100° F., and were examined microscopically on March 4th and 24th, and April 24th. The power used was about 500 diameters, and great care was taken to have the pipettes, slides, etc., clean at each observation.

The filtered distilled water showed bacteria in motion at the first examination,—more than a dozen on the slide. Twenty days later the bacteria were more numerous, and micrococci quite numerous. At the third examination, 20 days later, the bacteria and micrococci were still more numerous.

The ordinary solution protected by salicylic acid showed at the first examination both bacteria and micrococci,—the latter plentiful

At the second examination there was a slight increase, but at the third they remained about the same as at the second.

The ordinary solution protected by boric acid showed at first a

few bacteria and micrococci,—not as numerous as in the salicylic solution.

At the second and third examinations the numbers had increased each time, and at the last spirillium had appeared.

The freshly made solution protected by salicylic acid when first examined contained very few bacteria and no micrococci. At the second examination both bacteria and micrococci were present, but few in number, and at the third they were still few in number.

The freshly made solution with boric acid was very much the same as the last mentioned, at all the examinations.

The freshly made unprotected solution contained numerous bacteria and micrococci at the first examination, and these were increased in number at each subsequent examination.

From this report it is concluded that very minute microscopic organisms are present in freshly distilled water that has been filtered, and in all the solutions made from it,—that they increase in all such solutions, but less rapidly in those protected by salicylic and boric acids,—and that the difference between the two protective agents is not great.

But these are not the organisms that destroy the alkaloids in such solutions, and thus so rapidly weaken them. The particles visible to the naked eye which float about in the solutions or rest at the bottom, or which, when broken up by agitation, impair the transparency of the liquids, are growing plants, and as no mention is made of any such in the report, it is to be inferred that they were absent, and, therefore, in the ordinary sense, and to all practical purposes, all the solutions kept well during this forty days' digestion in the incubator,—including the unprotected solution.

It will be seen that all these observations, extending over about six months, are insufficient to establish anything more than a strong probability that boric acid in the proportion adopted,—namely, a half of one per cent.,—will protect these solutions, until they are used up in any ordinary practice, and therefore, the writer takes advantage of this probability, and hereafter will abandon the use of salicylic acid for the protection of solution of hydrochlorate of cocaine, and substitute boric acid. This boric acid will be used in the proportion of ·5 p.c. so long as there is no evidence of this proportion failing to protect. But in case it should fail in any considerable number of instances upon prolonged experience, the proportion will be increased to 1 p.c.

Some of the British journals have recently recommended camphor water as a good protective agent for these solutions, and rationally it should be protective as are all the substances belonging to the

aromatic series, but camphor is more irritant, or less sedative to mucous surfaces than boric acid, and the proportion necessary to protect does not seem to have been yet carefully determined.

FLUID EXTRACTS FOR MAKING DECOCTIONS, INFUSIONS, SYRUPS AND TINCTURES.

Almost all the makers of Fluid Extracts on a large scale publish and distribute formularies for the use of physicians and pharmacists, by which Decoctions, Infusions, Syrups and Tinctures are directed to be made from Fluid Extracts; and, judging by the inquiries for such formularies, they must be very popular, and in common use.

On looking through the Pharmacopœia, it will be found that not a single Decoction or Infusion is made from a Fluid Extract, and only seven of the Syrups and one Tincture are so made. It must be inferred from this that it is neither legitimate nor proper to make these preparations in this way, and it is certainly true that no preparation should be made or used under a Pharmacopœia title that is not made by the officinial formula. If it had been a safe and good practice to make these preparations out of fluid extracts, it must be held that the Pharmacopœia would have directed them to be so made. Or had the Pharmacopœia been willing to accept a somewhat inferior preparation in consideration of the saving of time and trouble by the shorter or easier process, it would doubtless have been done. But there is no indication of any such pharmacy in the Pharmacopœia. Hence these published formularies are arbitrary subversions of the Pharmacopœia, and, therefore, unwarranted, and the practice based upon them is all wrong. Their primary object seems to be that of an advertisement by which to sell more fluid extracts, and their adoption seems to be through laziness on the part of the physician and pharmacist. If it were conceded that the preparations made by these formularies were as good as when made by the officinal formulas, they are yet much more expensive, so that the slip-shod practice is not only subversive of principle and authority, but is costly as well. There should be no pharmacists who have not the skill and time to select their drugs and make their own galenical preparations. It is bad enough for them to buy their fluid extracts instead of making them, but much worse to use those so bought, in an unauthorized way.

But there are other objections to the practice. It is often, if not generally unsafe, and serious accidents have occurred from it, be-

cause a diluted fluid extract sometimes gives a very active precipitate, which settles to the bottom of the bottle, and is either filtered out and rejected or, if dispensed, increases the strength always to an injurious, and often to a dangerous degree.

But why should fluid extracts be diluted at all, excepting at the time of administration? One of the great advantages of this class of preparations is their concentration, whereby the much desired smallness of dose and accuracy of measurement is attained. By them more medicine can be carried in a given space than in any other form, and a country physician's pocket-case carries all he needs for his daily duties. The Pharmacopœia offers them as very much improved duplicates of Tinctures, Syrups, etc., but cannot and does not attempt to make them convertible into each other. The option of using the one or the other is given, but no authority to change either.

The only probable reason for physicians wanting to make Tinctures and Syrups from Fluid Extracts is that they have learned arbitrary doses of the former, and will not take the trouble to learn the equivalent quantities of the better preparations. If this be the chief reason, it is a very poor one, and entirely insufficient to justify the publication of formularies, even if such formularies were accurate in their equivalencies, doses, etc.

Most of the simple Tinctures which are represented by Fluid Extracts are of the strength of 10, 15 or 20 p.c. of the drug, while the Fluid Extracts represent about 100 p.c. of the drug, and are uniform in strength. It is, therefore, certainly not very difficult to learn that a Fluid Extract is ten times as strong as a 10 p.c. Tincture, and is, therefore, required in one-tenth of the dose;—or about 6.33 times as strong as a 15 p.c. Tincture;—or five times as strong as a 20 p.c. Tincture.

NITRITE OF AMYL.

In the Pharmaceutical Journal and Transactions of London, for February 28th, 1885, at page 702, there is a paper by Mr. D. B. Dott, F.R.S.E., the object of which is to criticise and expose the errors of the paper published by this writer in these pamphlets at page 701. Mr. Dott says that the doctrine taught "that amylic nitrite, when distilled, splits up largely into amylic alcohol and nitrous acid or its products of decomposition," is entirely erroneous, The writer did not intend to teach such a doctrine, and was not aware that his language would bear that reading of it. Being en-

tirely unacquainted with the absolute chemical substance, he was careful to say: "The Nitrite of Amyl used in medicine under this title (the title of the U. S. P.), does not seem to be the simple substance known as such to chemists, but is a rather complex mixture or compound of loose molecular structure, and varying considerably with the processes used for obtaining it."

This is that substance which has no fixed boiling point; and it appears from Mr. Dott's paper that he had never seen any that had a fixed boiling point, although very familiar with the chemical substance. That it is quite practicable for a chemist "to prepare a nitrite which distills altogether at 95°—100°C."—is neither doubted nor admitted, because it is outside the issue: yet it is submitted that dissociation must occur in a liquid whose boiling point moves by distillation from 95°—100° C.—or moves at all.

This, however, Mr. Dott says, is a small matter compared to the extraordinary results obtained by fractionating, which are set forth in a table; which results are not capable of any useful interpretation, on account of the peculiar method followed in fractionating.

Here, again, the paper criticised seems to have been so written as to have misled Mr. Dott; for it was the boiling points of the original liquid,—and not of the fractions,—which were sought, and which were stated in the table. The writer was not ignorant of the fact that by the use of a Henninger tube different results could be had, but he neither wanted nor sought such results, nor is he aware that he led his readers to think that such results were sought.

What was sought and stated was simply a comparative series of boiling points, intended to be useful by their relations to stated and measured fractions of distillates,—and after carefully re-reading Mr. Dott's criticisms the writer of the paper cannot yet see that useful information was not reached.

Next, the paper criticised nowhere takes the position that nitrate of amyl is one of the chief contaminations of the nitrite, but states that the chief contamination is amylic alcohol, and the next is likely to be nitrate of amyl, and the writer of the paper still maintains that liquids of very different boiling points will go over together in very considerable quantities during the distillation of mixtures, or of simple liquids which split up in distillation. Indeed, Mr. Dott only claims a "fairly complete separation," and this, by inference, from the use of a Henninger tube, though Mr. Dott simply says "by one distillation."

Mr. Dott has not the least doubt that the pressure developed in the vessels holding nitrite of amyl is from decomposition, and the

writer of the paper agrees with him, and yet adheres to the statement criticised that vapor tension is the cause of the pressure, for how else should there be pressure? Throughout the paper it is maintained that there is a spontaneous dissociation at common temperatures, which leaves a residue of amylic alcohol. This, of course, is decomposition of the complex liquid, though probably not decomposition in the sense intended by the critic.

Mr. Dott says: "It is almost refreshing to hear" that if the nitrite is preserved in glass stoppered bottles in a cool, dark place, it keeps indefinitely. This is an unusual form of criticism, and its meaning is somewhat obscure, but the sentence which follows leads directly to the inference that the statement is untrue. But the criticism can only lie, in justice, against the word "indefinitely," which word was perhaps not well chosen. The writer has had a considerable experience with the medicinal substance upon which the paper was written, and has kept it in good condition in a cool, dark place for various lengths of time up to perhaps two years, and never saw any spoil, and this was the meaning intended to be conveyed by the word "indefinitely." The writer is entirely without experience in regard to the keeping properties of a chemically pure or absolute nitrite, and did not intend any statements of the paper to apply to such, while Mr. Dott, perhaps, is most familiar with the nearly absolute chemical.

Finally, the scientific chemist sees and interprets the work given in these pages from a plane much above that of the practical physician and pharmacist. A boiling point or a weight given without corrections appear, as they really are, inaccurate; yet daily experience may show them to be more useful in practice than if corrected, because all boiling points or weights to be compared with them would require the elaborate processes of correction.

DISINFECTANTS.

At the annual meeting of The American Public Health Association, held at St. Louis in October, 1884, a very important committee was appointed to investigate the subjects of disinfectants, germicides and antiseptics, and formulate the results of their research, so as to make the existing knowledge on these topics available for professional and popular use.*

This committee consists of seven prominent sanitarians, all pre-

* Medical News, Phila., Jan. 24, 1885, p. 87.

viously identified with similar investigations, and some connected with important Boards of Health, and is under the chairmanship of Dr. George M. Sternberg, Major and Surgeon in the U. S. Army.

Several members of this committe have made preliminary reports, which are published in the Medical News of Phila. for Jan. 24th, Feb. 7th and 21st, March 14th, 21st and 28th, and April 11th. These subordinate reports were summed up by the chairman, by request of the Sanitary Council of the Mississippi Valley, and thus condensed into a general preliminary report the matter was presented at a meeting of the Committee on Disinfectants, specially convened for its consideration, and after careful consideration was adopted. See Medical News, Phila., April 18th, 1885, p. 424, where the general report is published in full.

Subsequently this report was somewhat modified, and published, without date or specifically stated authority, in pamphlet form, presumably by the committee, for general circulation and use. The title of the pamphlet is "Disinfection and Disinfectants—Preliminary Report made by the Committee on Disinfectants of The American Public Health Association."

The report begins with the following paragraph :

"The object of *disinfection* is to prevent the extension of infectious diseases by destroying the specific infectious material which gives rise to them. This is accomplished by the use of *disinfectants.*"

The special diseases which are enumerated as yielding infectious material to be destroyed are cholera, yellow fever, typhoid fever, typhus fever, diphtheria, scarlet fever, small pox, tuberculosis, and some forms of dysentery and pneumonia. But others, such as anthrax, septicæmia, etc., are left to inference.

Germicides, or substances which in small proportion kill germs, are stated to be all disinfectants, but disinfectants are not necessarily germicides.

In common usage, the word disinfectant is erroneously understood to embrace antiseptics and deodorizers, but a differentiation is strongly urged, because antiseptics and deodorizers, however important and useful, are not true disinfectants or germicides at all.

Yet the published experiments of the committee show that this sharp line of difference drawn, is, in some instances at least, only a quantitative difference. For example, corrosive sublimate is a true germicide and disinfectant, because it kills germs in a definite time when of a definite strength, the time being short and the strength feeble : that is, the quantity being small. Chlorinated lime is also a true disinfectant, although to yield the same germi-

cide power, a longer time or a larger quantity are required. But carbolic acid is not a true disinfectant but is only an antiseptic, because it only destroys germs where used for a longer time and in much larger quantity.

The agents recommended as true disinfectants and germicides are only three in number, corrosive sublimate, chlorinated lime and its equivalent chlorinated soda, and potassium permanganate, and they seem to stand in this order of value. But corrosive sublimate, from its poisonous character and greater cost, is recommended for general use with much caution, while the chlorinated compounds are stated to be nearly as good for most uses, and "perhaps entitled to the first place" for others, their chief disadvantage being their odor, while corrosive sublimate is odorless.

In view of the already reported cases of acute and chronic poisoning since the fashion of using corrosive sublimate has became popular, this caution on the part of the committee is certainly not misplaced, for in the judgment of the writer it would be very unsafe to dispense solutions of corrosive sublimate, even though colored with permanganate of potassium, for popular use as a disinfectant.

It is a curious circumstance that after all the years during which chlorinated lime and soda have been in professional and popular use as disinfectants, they have gradually lost reputation until now, when this committee places them in the first rank, and thus gives them an importance they have never before had, even when their utility was first shown. Now they seem destined to come into very prominent notice and use, and to play a most important part in the efforts to limit and control infectious diseases, as well as to prevent them. This being one of the most important interests of humanity, the agents to be used certainly merit a more careful attention, and it is the aim of this note to attract that attention by offering some practical information on the subject of these chlorinated compounds.

Chlorine is doubtless the effective element in the disinfectant process. But free chlorine and all the chlorides seem to be far less effective than chlorine in combination with oxygen and hydrogen as hypochlorous acid. This acid unites with bases to form hypochlorites, but neither the free acid nor its salts are very permanent. The salts are, however, much more permanent than the free acid, and with proper precautions they can be preserved for use for a considerable length of time, though not indefinitely. The ultimate action of these hypochlorites in bleaching and disinfecting are probably the same, and depend upon the decomposition of the acid, and the reduction of the hypochlorites to chlorides, the power being

exerted not by either of the elements, but during the change from one combination to the other. Thus the hypochlorites being active while the chlorides are inactive, and the power of action residing in the process of changing from one to the other, and this change going on continuously, though slowly under some conditions and rapidly under others, it follows that the measure of the value of any solid or liquid substance containing hypochlorous acid, is the proportion of this acid in the substance, which remains unchanged into inactive chlorides. That is, the chlorine present in the condition of hypochlorous acid is available for bleaching and for disinfecting, while the chlorine present as chlorides is not available.

The bleaching power of hypochlorous acid and the hypochlorites was known before the acid and its chemical relations were, and hence the combinations were called "chlorinated" compounds, and thence came the names chlorinated lime and chlorinated soda, and the value of these was measured by the proportion of available chlorine which they might contain at the time of the assay.

The first hypochlorite used for bleaching was a solution of the potassa salt called Eau de Javelles, from the bleaching establishment where it was first made by Berthollet about 1785, and this Eau de Javel, as it is not unfrequently written, has been used as a disinfectant for just about one hundred years. Tennant, of Glasgow, appears to have been the first to make the hypochlorite of lime about 1798, but as chlorine was not recognized as an element until about 1809, the name chlorinated lime must have been applied much later.

To this chlorinated lime, and a solution of chlorinated soda the committee now invite especial attention, and both are officinal in the U. S. Pharmacopœia and are described as here quoted.

"CALX CHLORATA.

CHLORINATED LIME.

[CALX CHLORINATA, *Pharm*, 1870. CHLORIDE OF LIME.]

A compound resulting from the action of Chlorine upon Hydrate of Calcium, and containing at least 25 per cent. of available Chlorine.

Chloride of Lime should be preserved in well-closed vessels, in a cool and dry place.

A white or grayish-white, dry, or but slightly damp powder, or friable lumps, becoming moist and gradually decomposing on exposure to air, having a feeble, chlorine-like odor, and a disagreeable, saline taste. It is partially soluble in water and in alcohol. On dissolving Chlorinated Lime in diluted hydrochloric acid, chlorine gas is given off, and there should not remain more than a trifling amount of insoluble matter. Its solution in diluted acetic acid yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric acid. The aqueous solution quickly destroys the color of a dilute solution of litmus or of indigo.

If 0.71 Gm. of Chlorinated Lime be mixed with a solution of 1.25 Gm. of iodide of potassium in 120 C.c of water, and 9 Gm. of diluted hydrochloric acid be then added, the red-brown liquid should require for complete decoloration not less than 50 C.c. of the volumetric solution of hyposulphite of sodium."

This substance is commonly known as Bleaching Powder, and the name is often contracted in the vernacular into "Bleach." It is partly a mixture and partly a combination of hypochlorite and hydrate of lime with calcium chloride and carbonate, and moisture. It is unstable in composition, but changes and loses value more or less rapidly in proportion to the greater or less exposure to air and moisture.

It is made in enormous quantities for uses in the arts,—chiefly for bleaching purposes, and is imported into this country generally from England and Scotland in casks of from 800 to 1,300 pounds, or thereabout. Its sensible properties are a very uncertain indication of its value, since while the odor, taste, etc., may be still strong it may be nearly worthless. Its entire value in medicine as in bleaching depends upon the percentage of available chlorine, and this proportion diminishes more or less rapidly from the time it leaves the hands of the manufacturer until it disappears altogether. In the loose, paper lined casks it loses slowly, and chiefly from the portions next to the cask, the central portions undergoing but little change in any reasonable length of time. But when a cask is opened for use, and the surface is exposed to the damp air of a cellar, as is commonly the case in retailing it, the loss is rather rapid, and the weakest portion is successively sold, exposing a fresh surface to lose strength in its turn. Thus a cask of high-test Chlorinated Lime, in proportion to the rate at which it is sold, may be of much lower strength when it reaches the pharmacist from the wholesale druggist, and be much lower still when it reaches the consumer, and may even become worthless without the slightest adulteration, and without betraying its condition to ordinary observation. This is a very common difficulty in the way of its use for disinfection, and may be an important element in its having fallen into disuse. When a cask is opened, a thin exterior shell of the powder should be rejected, and the remainder should be at once put up in closely packed jars or bottles, and be tightly corked. When thus put up it still changes, though very slowly, and the rate of change is reduced to a minimum, so that, if of good quality when put up, it may be relied upon to change very little in value within a year or two at least.

The Pharmacopœia says it must contain at least 25 p.c. of available chlorine by its process of assay, to be officinal, but gives no maximum proportion. This standard adopted 35 years ago has now

been too low for 20 years past. The standard strength of British manufacturers has long been 32 p.c. of available chlorine, and it would be difficult to find in first hands any below 30 p.c., while 35 to 37 p.c. strength is always accessible, and 38 to 40 p.c. not very uncommon. These higher proportions should alone be used, for medicinal and disinfectant purposes, and they should by all means be put up so as to secure this strength up to the time of use, beyond reasonable doubt. The practice of this writer is to buy the highest test, and freshest from the manufacturer, and then to put up the central portions of each cask in well packed and well stopped bottles of 2 pounds each.

Chlorinated lime is a very inexpensive substance. The committee say the cost is not over five cents per pound, and for such a price a very good article should be always easily accessible in any considerable quantity. But the committee forgets that it must have a container other than paper if to be successfully used for disinfection, and a container that will secure it in good condition in small quantities for popular use costs far more than the substance.

The powder is sold in casks at the rate of one and three-quarter cents per pound for 32 p.c., equivalent to about 2.02 cents for 37 p.c. strength. This the wholesale druggist cannot sell out in barrels, kegs, jars, etc., as ordered, for less than three to three and a half cents, in proportion to the time, labor, etc., put upon it.

Then the pharmacist must get five or six cents for it, at least; but all this is upon the supposition of the bad practice of putting up in loose packages or in paper, in which condition it soon becomes more or less of a delusion and a snare in actual use.

The writer's experience may be worth giving in this connection, by way of illustration, as well in other substances of low prime cost, as in this.

The actual cost of good heavy two pound, wide-mouth bottles is $6.80 per gross, and accidental breakage in storing and washing the bottles makes the yield average 140 bottles to the gross, or 4.86 cents each.

Corks of good quality for protecting the strength, and long enough to be taken out and put in by the fingers during use, actually cost $2.00 per gross, and the actual yield per gross is about the same as with bottles, or 140 to the gross, or 1.43 cents each. A label for the bottle and another for the wrapper, and the paper for the wrapper cost not less than .24 cent, making the actual cost of materials 6.53 cents. The labor of cleaning the bottles, filling, corking, labeling and wrapping has to be rather roughly estimated, and is more or less in proportion as it is well done and liberally paid for, but under favorable circumstances it is not probably below two and a quar-

ter cents per bottle. Then the general expenses of a business, including superintendence, office expenses, interest on capital, wear and tear of apparatus and appliances, breakage, bad debts, etc., is always very high upon bulky articles of low cost, and may be estimated at not less than 20 p.c. on the actual cost of such articles. Then, as the actual cost of 2 pounds of chlorinated lime is 4.04 cents without estimating for loss in weighing out or in shortage on the casks, and as the bottle put up and finished costs 8.78 cents, the prime cost becomes (4.04+8.78)=12.82 cents. If to this be added say 20 p.c. for the cost of a manufacturing business upon articles of low cost, and the secondary cost becomes (12.82+2.56)= 15.38 cents per bottle of two pounds. Finally the profit has to be added. While a mercantile business of fair proportions can be carried on to advantage with a net profit of 6 to 8 per cent., a manufacturing business is worth more, because the percentage is applied to smaller totals and to a different order of work. Such a business to be worth carrying on should yield a profit of 10 to 12 p.c.—say 10 p.c. Then the cost being 15.38 cents and the profit 1.54 cents, the total becomes (15.38+1.54)=16.92 cents per bottle or $2.03 per dozen, and the price charged for them is $2.25, less 10 p.c. discount, without a packing box, or $2.75 with box.

It would thus appear, that in order to secure 2 pounds of Chlorinated Lime costing originally 4.04 cents, so that it shall not disappoint the user, or fail in the objects to which it is applicable, an expenditure of about 13.15 cents, or more than three times the prime cost, is required, making the committee's estimate of 5 cents per pound much too low, even while the bottles are still in first hands. When at least two other profits are added, as must happen before they reach the consumer, the cost is still greater.

The Pharmacopœia assay process for Chlorinated Lime is that of Bunsen, and is an excellent one, only that the quantity of volumetric solution of hyposulphite of sodium should be increased from 50 to 70 c.c. if the minimum strength be increased to 35 p.c. for the lime salt.

The "Standard Solution No. 1," of the committee, is made by dissolving Chlorinated Lime, or Chloride of Lime as they call it, of the best quality, in soft water in the proportion of four ounces to the gallon, and their direction is:

"Use one pint of this solution for the disinfection of each discharge in cholera, typhoid fever, etc. Mix well, and leave in the vessel for at least ten minutes before throwing into privy-vault or water-closet. The same directions apply to the disinfection of vomited matters. Infected sputum should be discharged directly into a cup half full of the solution."

The committee do not say so, but, of course, about half an ounce of the Chlorinated Lime in powder, mixed well, as directed with each discharge, would be more effective, and save the time, trouble and the vessel for making the solution.

The powder or solution may be used freely without danger, and without damage to white fabrics generally, but colored fabrics are all more or less bleached and spoiled by them.

These directions for use are put upon the labels of the bottles, and one or two of these bottles well applied should be enough for an ordinary case of infectious disease.

The formula and process of the U. S. Pharmacopœia for its solution of Chlorinated Soda is as follows:

"LIQUOR SODÆ CHLORATÆ.

SOLUTION OF CHLORINATED SODA.

[LIQUOR SODÆ CHLORINATÆ, *Pharm.*, 1870. LABARRAQUE'S SOLUTION.]

Carbonate of Sodium, *one hundred parts*	100
Chlorinated Lime, *eighty parts*	80
Water, *a sufficient quantity*	
To make *one thousand parts*	1,000

Mix the Chlorinated Lime intimately with *four hundred* (400) *parts* of Water in a tared vessel provided with a tightly fitting cover. Dissolve the Carbonate of Sodium in *four hundred* (400) *parts* of boiling water, and immediately pour the latter solution into the former. Cover the vessel tightly, and, when the contents are cold, add enough Water to make them weigh *one thousand* (1,000) *parts*. Lastly, strain the mixture through muslin, allow the precipitate to subside, and remove the clear solution by means of a siphon.

Keep the product in well-stopped bottles.

A clear, pale greenish liquid, of a faint odor of chlorine, a disagreeable and alkaline taste, and an alkaline reaction. Sp. gr. 1.044 Addition of hydrochloric acid causes an effervescence of chlorine and carbonic acid gas. It rapidly decolorizes indigo, and produces a copious, light brown precipitate with solution of ferrous sulphate.

8.88 Gm. of the Solution, when mixed with a solution of 2.6 Gm. of iodide of potassium in 200 c c. of water, and afterwards with 18 Gm. of hydrochloric acid and a little gelatinized starch, should require, for complete decoloration, not less than 50 c.c. of the volumetric solution of hyposulphite of sodium (corresponding to at least 2 per cent. of available chlorine)."

The above formula is a very good one for this Solution, but it is based upon a Chlorinated Lime which is too weak for the purpose. With a powder containing 25 p.c. of available chlorine and good management, it gives a solution containing the required 2 p.c. of available chlorine. But with the Chlorinated Lime of the market at the present day, and with a proportionate increase in the Carbonate of Sodium, say from 100 to 120 parts, it yields a solution containing about 3 p.c.

In the process of assay the word diluted must have been accidentally omitted before "hydrochloric acid," because it is diluted hydrochloric acid that is required.

Even with 3 p.c. of available chlorine, this solution is much weaker than it need be, because the bottle required to hold it is so costly in proportion to the liquid and its effects in use. Bottles to hold this solution properly should be glass-stoppered, because the solution gradually though slowly destroys cork, and is itself decomposed in proportion as it destroys the cork. But glass stoppers have to be accurately ground and be very tightly put in to prevent leakage, and after having been in for a week or two become so tightly cemented that in a large majority of cases the bottle has to be broken to get at the contents. Beside, glass-stoppered bottles are nearly double the cost of corked ones. Heretofore the writer has always put up the solution of about 2.2 p.c. of available chlorine, and always in glass-stoppered bottles. But now that the work of this committee will be likely to increase the importance of the preparation and the demand for it, he has determined to try to cheapen it by making it of 6 p.c. strength, simply by reducing the proportion of water in the formula, and putting two pints or two and a quarter pounds of this into a cork-stopped bottle. The cost of a 2-pint bottle for this solution, and of putting it up, is very nearly the same as in the case of Chlorinated Lime, and the cost of the solution is hardly greater than of the powder, therefore, the reasons for getting more into the bottle in order to lessen its proportionate cost, are as good as in the case of the powder. The difference between making and putting up a solution of 3 p.c. strength, and one of 6 p.c., is really not over 1½ cents for a bottle of 2 pints, so that while a 3 p.c. solution could not be sold at less than about $2.34 per dozen, a 6 p.c. solution can be sold at $2.50, thus affording twice the value in contents for about 1½ cents per bottle difference in price, while by the label on the bottle the proper directions for dilution are easily given. The only doubt as to the propriety and economy of the new departure is as to the durability of the corks in getting the liquid safely to its destination in use.

The committee use the name "Labarraque's Solution," giving the old Latin title "liquor sodæ chlorinatæ" in parenthesis as an equivalent title, and the Pharmacopœia also gives Labarraque's Solution as a synonym of its new title, Liquor Sodæ Chloratæ.

Both these authorities are in error in this. Labarraque's Solution as sold in the markets is a very much weaker preparation, often, if not generally, testing under 1 p.c. of available chlorine. That is, about half the strength of the Pharmacopœia minimum.

and about one-third the strength required by the committee in their "Standard Solution No. 3."

This "Standard Solution No. 3" is directed to be made and used as follows:

"*To one part of Labarraque's Solution* (*liquor sodæ chlorinatæ*), *add five parts of soft water.*

This solution is more expensive* than the solution of chloride of lime, and has no special advantages for the purposes mentioned. It may, however, be used in the same manner as recommended for *Standard Solution No.* 1.

Disinfection of the Person.—The surface of the body of a sick person, or of his attendants, when soiled with infectious discharges, should be at once cleansed with a suitable disinfecting agent. For this purpose *Standard Solution No.* 3 may be used.

In diseases like small-pox and scarlet fever, in which the infectious agent is given off from the entire surface of the body, occasional ablutions with Labarraque's Solution, diluted with twenty parts of water, will be more suitable than the stronger solution above recommended.

In all infectious diseases the surface of the body of the dead should be thoroughly washed with one of the standard solutions above recommended, and then enveloped in a sheet saturated with the same."

To make this "Standard Solution No. 3" from the 6 p.c. solution as put up by the writer, and described above, it is only necessary to double the dilution. That is, instead of one part to five of water, it should be one part to ten of water to give the same strength.

Dilutions of different strengths have long been used with advantage as washes, and upon the top dressings in surgical diseases and injuries, and there are probably no better disinfectants for such purposes, as well as for general household uses in preventing sickness. But it should never be forgotten that neither this nor any other disinfectant will take the place of cleanliness, or be of much avail where cleanliness is not first attained.

The principal objections to these chlorinated compounds as general disinfectants is the odor. This is very disagreeable to some persons, but as a general rule is hardly noticeable after the first day's usuage. Labarraque's Solution has a considerable advantage in popularity over the officinal solution, on account of the comparatively slight odor. But when it is known that this is due to the feeble-

* "We assume that the solution used will contain at least 3 per cent. of available chlorine, which would give us 0.5 per cent. in the diluted solution. The cost per gallon of the undiluted solution should not be more than fifty cents by the quantity. This would make our standard solution cost between eight and nine cents a gallon."

ness of the solution, it will be seen how unsafe it is to trust to popular favor as a guide in medicinal agents.

Much of the discredit through which these substances have fallen into comparative disuse is doubtless due to the feeble condition in which they reach the hands of the consumers, and this discredit must be removed if they are to fulfill the expectations of this committee.

A very important element, perhaps the most important next to quality and strength,—is the cost of these agents, and it may be worth while to follow them into use in relation to cost. It has been shown in connection with Chlorinated Lime,—and it is about the same with this preparation made from it, that the net profit to the manufacturer is about 1½ cents per bottle, and that he must sell 100 gross or 14,400 bottles to make $216.

The wholesale dealer who buys them from the manufacturer should not make less than 10 p.c. after having paid for transportation, and risks and losses. When packed for transportation a box costing at least thirty cents is required for each dozen bottles, and the cartages, freight and breakages will easily bring the additional expense up to fifty cents per dozen bottles. Therefore, out of the immediate vicinity where they are put up, the additional cost will be proportionate to the distance, but will rarely be less than fifty cents per dozen. Thus the 6 p.c. solution will cost the distant wholesale druggist not less than $2.75 per dozen. If he makes, as he should, 10 p.c. upon this, he must sell them at $3.02½, a profit of only a little more than 2 cents per bottle. But the pharmacist, who buys them to dispense to consumers, must have a much larger profit than this if he is to be expected to put them in competition with the worthless articles that pay him so much better profits. As they reach him these bottles cost a little over 25 cents each, and he should have at least 5 or 6 cents profit, or about double what the manufacturer and wholesale dealer together get, because he can get this off of all sorts of advertised nostrums, and can hardly be expected to sell that upon which he makes least money. Hence the bottle reaches the consumer at a cost of say not less than 31 cents, and it will make 20 pints or 2½ gallons of the "Standard Solution No. 3," of the committee, at a cost of a little over 1⅓ cents per pint, slightly above their estimate of 8 to 9 cents per gallon. But more than three-fourths of this cost is for the container and its necessary expenses. No better illustration could be had of the great difference between the prime cost of the 6 p.c. solution, which is hardly over 4 cents for two pints, and the cost to the consumer, which is just about eight times greater.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. JULY, 1885. No. 10.

ABSOLUTE ALCOHOL.

In a second note on the subject of absolute alcohol at page 586 of this series of pamphlets, the writer expressed his impression that in having reached an uncorrected specific gravity of ·79350 (see page 535), the limit of dehydration by lime had not been attained, and that with an improved apparatus and management resulting from his experience and facilities, a still lower specific gravity, or a more complete dehydration by lime might be reached.

With the object of pressing the investigation still farther, a percolator was set up which contained about 28 kilogrammes of granulated or coarsely powdered quick-lime, which had just been ignited during 5 hours in a blast-furnace. About 16 litres of alcohol, including that used in the last determinations, was passed and repassed through this lime without access of external air, but under normal atmospheric pressure. The receiving and supply bottles were so arranged during the percolation that the same air remained in the whole apparatus throughout the time, and in equilibrium throughout the apparatus, the air spaces being in communication with the external air only through a large chloride of calcium jar. The dropping from the percolator into the receiving bottle averaged about four litres a week, and the percolation was carried on for thirty-three weeks, so that the entire 16 litres passed through the lime eight times.

During this long percolation the alcohol became deeply colored, and deposited an incrustation of a brown color upon the bottles and in the tubes, so as to threaten interruption of the process by occlusion of the tubes. For this reason, at the end of the thirty-three weeks the rate of percolation was doubled, and each bottle as it came through was distilled in a thoroughly dried, air-tight distillatory apparatus, under a partial vacuum, or minus pressure of about 15 inches of mercury, before it was returned to the top of the lime.

In this way the total alcohol was passed through the lime twice more, making 10 times in all, and was now again nearly colorless when it came through.

During the first efforts at dehydration, as described at page 522 et seq. of the number of these pamphlets for May, 1884, several points were in doubt, and several small errors of management and of statement were made which it was the object of this repetition to set at rest and correct, and indeed the whole process was undertaken in order to confirm or refute the previous results, as well as to seek for a lower specific gravity, or more complete dehydration which was supposed to be within reach of the lime process.

The standard for correcting the thermometers used in the former trials was not known to be absolutely correct at the part of the scale used, and as a tenth of a degree in temperature of so expansible a liquid made a difference in specific gravity affecting the fourth decimal place, it was important that the standard should be known to be correct. A new standard thermometer was therefore obtained from the Kew Observatory, which had been recently certified by the Superintendent, Mr. Whipple, with especial reference to the part of the scale to be used. This instrument, No. 630 of Kew, was graduated to tenths of a degree and could be easily read to one-fortieth, and was very sensitive; and by it the standard previously used was confirmed, thus removing an important doubt.

Next the large specific gravity bottle, described and figured at page 529, had a small variable error in weighing, which might have been due to leakage at the ground joint or stopper. Another similar bottle was therefore made with greater care, which after standing six months for contraction of glass about the stopper,—the flask itself being old,—was carefully marked, the bath being regulated with great care. Upon a trial of this flask it was found to agree very closely with the older one, and thus the weighings were found to have been correct. This second flask was, however, used in the re-determination, because it was a little more easily managed in closing. This flask, like the first one, was counterpoised by one of the same size, and made of the same glass, so as to avoid the necessity for a correction in the tare, had brass weights been used in counterpoising. As the counterpoising flask was hermetically sealed with the barometer at 30.05 inches, the counterpoising varied from ·01 to ·03 gram. as the barometer was above or below 30 inches at the time of the weighings, and the weighings were made with this difference corrected, as well as without the correction. The flask was used in a larger bath than before to obtain greater steadiness of temperature.

Another point in the previous paper which admitted of some doubt, was whether the contents of the flask were of the same temperature as the bath after the column had ceased to rise or fall during ten minutes,—the bath being kept constant. This was tried both with water and with alcohol, and the temperature of the bath was found to indicate the temperature of the contents of the flask with great accuracy.

The specific gravities given were, as stated, all apparent specific gravities; that is, the volumes were compared with equal volumes of water at the same temperature, and therefore no correction for expansion of glass was needed, but brass weights were used, and no correction for difference in density was made, and, therefore, the specific gravities were, as far as this correction is concerned, apparent only and not true specific gravities. From some mental confusion at the time of writing, this correction was stated to be subtractive,—that is, the true s. g. was stated to be lower than the observed. This, of course, was a gross blunder, for the true s.g. is greater than the observed, by the difference in the weight of the volume of air occupied by the brass weights and by the flask and contents. This correction was omitted, first, because it is of practical importance that it should be omitted in the case of alcohol, in order to facilitate comparison with the adopted standards in use, such as those of Drinkwater, where it was omitted; and next because it affects the fifth decimal place, and is therefore beyond the sphere of error in ordinary weighing and reading.

The tables which are in practical every-day use commonly give specific gravities to the fourth decimal place, and they rarely if ever state whether these specific gravities are true or apparent. Frequently the temperature of the standard volume is also omitted. Hence it is, perhaps, fair to assume that they are uncorrected, and that the temperature of the standard volume is the same as that at which the weighings are made. If this be so, then apparent, specific gravities are the most useful, and those which are corrected are only confusing.

Another point of interest, neglected in the last paper, was not neglected in these later trials. It is known that carbonic anhydride as well as air is absorbed or dissolved by alcohol, and must affect its specific gravity. In these trials the air which supplied the desiccators was first passed through caustic potassa solution, then through a sulphuric acid bottle and column, and finally through two chloride of calcium jars.

The distillations and weighings were made with all the precau-

tions that could be thought of, and are believed to be fairly accurate to the fifth decimal place.

The distillations were of about 4 litres each, and were aspirated into the apparatus, which had been previously charged with dry air, and many distillations were made at the normal atmospheric pressure, although most of them were made under a minus pressure, which varied between 13 and 23 inches of mercury. The receivers were always carefully filled with dry air, and were under the minus pressure made by the water-pump.

From the very first distillations from the lime it was noticed that the appearance of boiling commenced at a very low temperature, and preceded the actual ebullition by some 15 to 20 minutes, the bubbles given off increasing in number and size until actual ebullition occurred. The gases or vapors thus given off were not condensible at the temperature of melting ice, and were simply drawn over by the pump. The distillations were made from platinum scraps, which were ignited each time, and the boiling was rarely explosive, and when thus irregular it was only for the first ten or fifteen minutes. The distillations were always arrested with about 100 c.c. of residue in the flask, and these residues were thrown away. Contrary to what was expected, no distillation was obtained at a constant boiling point from first to last. In the alcohol, as it came from the lime, the boiling point rose from 2° to 3° C., and this, taken in connection with the presence of uncondensible gases, and an examination of the residues, indicated plainly that the long exposure of dehydrated alcohol alternately to the lime and dry air had caused a small proportion of it to split. The specific gravity of the total distillate, as it came from the lime, was very uniform, and compared with water at 15.6° C., and weighed at this same temperature, it only varied between ·79363 and ·79368.

When the distillate was divided into three fractions of about one-fourth for the first and last fractions, and about one-half for the middle one, the s.g. of the middle portion was found to be lower,—generally about ·79355 to ·79358.

The middle portions put together and again fractioned, and these middle portions again put together and fractioned gave a final middle portion weighing ·793530, as the best result obtained, and this last distillation of middle fractions had not a constant boiling point even for its middle portion, the variation in boiling point being possibly as much as ·2° C. The variations in the partial vacuum made this variation very difficult to estimate with accuracy.

This result was not quite so low as that obtained in the weighings of the previous paper, where ·79350 had been reached, and it was,

therefore, disappointing after so much care and pains; but it is considered to have established the fact that long contact with lime and dry air splits a small proportion of anhydrous alcohol into other compounds of its elements.

It is highly probable that light is an important factor in this change, since, on the large scale in large boiler-iron percolators, and in the distillation of large quantities the change is not perceptible.

Having thus been disappointed in reaching a lower s.g. than before by this management, the former process, as described at p. 531, was repeated, but without gaining anything upon the results there given, and therefore it is concluded that with the means and under the management described, a s.g. of ·79350, at 15.6° C., compared with water at 15.6° C., uncorrected for brass weights used, is the lowest obtainable point for ethylic alcohol; and that ·7940 is so easily obtained in practice on the large scale, that in commerce "absolute alcohol" should not be accepted as such when above this s.g., when fresh parcels of it are first opened and weighed without much exposure to air.

DISINFECTION.

Whether misroscopic organisms be the cause or consequence of disease, or whether these organisms be in themselves or in their pabulum, or by their spores, agents of infection, it must be admitted that their agency is limited and controlled by conditions of time, place and circumstance, and that therefore these conditions become at least equal in importance to the organisms themselves. That is, there are at least two factors to the process of infection which if not of equal value are equally indispensable, and which bear a relation not unlike the interdependence of the sexes.

While biological investigations are pushing one of these factors,—namely, the germ theory of the origin of disease,—with the greatest ability and activity to results of great importance, the other factor is not investigated with the same activity and enthusiasm, but is rather left to the wandering devices of empiricism.

If there be a specific germ for each infectious disease, and that germ be of itself perfectly infectious, every germ should produce the disease under all conditions, and it would be only necessary to control the germs to limit the disease, and to kill all the germs would be to eradicate the disease. It is known, however, that no infectious disease has been eradicated, and it may therefore be inferred that the germs are not absolutely controllable. But it is also known that many infectious and epidemic diseases were controlled and their

ravages prevented long before a germ theory was thought of, and by processes of disinfection that were not germicide in the present acceptation of that term.

It may be concluded then that the process of infection requires first, a power to infect,—or infectious matter ; and second, a condition susceptible of being infected, and practically, that infection cannot occur without both elements to the process. Perfect disinfection will therefore result from a control of either one of the elements essential to the process, whether the other be controlled or not. If this be true, however, it by no means indicates that either element of the process should be considered to the exclusion of the other, but rather that each should receive due attention, and thus most effort will be expended upon that element which is within easiest practical reach.

Some modification of the germ theory being admitted then, germicides become very important agents in disinfection. But as it is manifestly impossible to reach all the germs of any disease, the older, and thus far the most effective practice of cultivating and extending the germ-proof condition becomes of more importance still.

Almost all that is absolutely known of this germ-proof condition is embraced in the general acceptation of the word cleanliness. Personal cleanliness may not always render single individuals germ-proof, but community cleanliness would probably render communities germ-proof, for, as a matter of fact, the cleanest districts are least affected by infectious diseases, even in epidemics when the germs are in such enormous numbers as to be present everywhere in almost equally effective force. Irrespective of the conditions of being well fed, well clad and well housed, the cleanly classes of all communities appear to suffer least from infectious diseases whether such occur in sporadic or epidemic forms, the number of cases as well as the number of deaths being fewer.

Therefore as uncleanliness is willful and voluntary, and is never enforced or compulsory, disease from it must be regarded as the penalty of broken law, and as illustrating forcibly the expression of Emerson that "The law at the foundation of all things is retribution."

There are not only various kinds of uncleanliness, but various degrees of the same kind, which variously intensify the forces of infection, and those which are most hurtful, in both kind and degree, involve some process of destructive or reconstructive decomposition. The elements of filth are innocuous, whether separately or combined, and probably afford no pabulum for germs, nor any organic poisons

of any kind, until a series of chemical reactions occur which ultimately result in such harmless products as carbonic acid and water. But these products are reached through complex stages which yield generation after generation of microscopic life, and of poisons like the ptomaines. How this kind of filth, which accumulates around human habitations and becomes most hurtful where uncleanly human beings are most numerous,—tends to multiply and intensify infectious diseases, is not understood, but that it has such an effect is not doubted ; nor is it doubted that this effect is produced by the chemical and biological processes of decomposition. It is not then the elements of the filth which promote infection, but the processes by which they are decomposed, and the problem for disinfection is to remove or destroy the elements, or to prevent, arrest or modify their hurtful processes.

Most of these processes,—if not all of them, are of the nature of fermentation, and as such are arrested with comparative ease by a large class of chemical agents, and it is in this way that these become disinfectants.

The entire atmosphere being filled with microscopic germs, and in this sense always infected, every object directly or indirectly exposed to it is abundantly supplied with such germs awaiting the conditions necessary to their development and multiplication ; and in general terms these conditions are first a pabulum and then warmth and moisture. Without the chemical reactions which yield them pabulum or food they do not develop, and without these they may have neither of the other essentials to development. In this condition immense numbers of them doubtless die, and others linger upon the border line between life and death, to be easily destroyed by many agencies in many ways. But a comparatively small number simply await the conditions necessary to development, and this number is doubtless controlled by the law of " survival of the fittest." They are, however, harmless without the conditions for development, and as these conditions, though present, may be more or less favorable, the development will be more or less active and more or less hurtful as the short-lived generations maintain the perfect type or degenerate from it.

Disinfection, then, means either the prevention, the modification or the arrestation of these processes, whether it be in the body and its surroundings in individual cases of infectious disease, or in the uncleanliness of whole communities,—whether the germs be those special to a disease or those of the general processes of decomposition,—and disinfection may be perfect, or as complete as is possible

under the conditions of the problem, without absolute destruction of the germs or poisons.

It is altogether improbable that the infectious material of any case of disease, whether this material be germs or not, can all be destroyed by any disinfectant or germicide however potent, or however copiously applied. All that can be rationally expected is to diminish the chances of spreading infection to a minimum ; and this will be accomplished not so much on the proportion of germs destroyed, and germs from which the conditions of development are withheld, as by surrounding the case with germ-proof conditions of that absolute cleanliness which so reduces the susceptibility to all infection.

In some such way is disinfection well applied to both factors of the process of infection.

The doctrine of some biologists that no substance is disinfectant which is not a germicide seems liable to misconstruction, not only because it does not apply equally to both factors in the process of infection, but also from two other considerations: First, as to whether a given substance is a germicide or not, is often a question of quantity or proportion, and this is decided by the effect upon special organisms in special cultivation liquids. A substance in a stated proportion in a definite time kills certain organisms, and is, therefore, a true disinfectant because it is a germicide. Another substance in greater proportion or in a longer time also kills these same or other organisms, but is not considered to be a disinfectant because of the larger quantity or longer time required.

Again, antiseptics are not admitted to be true disinfectants, because they do not in small proportion kill some specific organisms of cultivation fluids, nor prevent their multiplication. But this applies only,—and is intended to apply only to the germ factor of infection, and this under artificial conditions that may be similar to this factor in natural infection.

The biologists nowhere doubt the value of antiseptics in the case of the second factor of the process of infection, namely, in preventing or arresting those processes through which uncleanliness and filth develop the susceptibility to infection, and without which susceptibility the germs are comparatively inoperative.

It matters little practically whether a given agent kills the germs or so modifies the conditions around them as to render them harmless, as antiseptics appear to do even when not in sufficient proportion to be germicides.

Antiseptic dressings to wounds and injuries, whether acting as true disinfectants or germicides, or merely as systematic forms of

scrupulous cleanliness, have done so much to reduce mortality and mitigate suffering that their value can hardly be disputed.

Again, in the treatment of all forms of filth and uncleanliness in communities or districts where the authorities have not the power or means to prevent or remove the accumulations, antiseptics, by preventing or arresting the chemical processes which precede and accompany the biological processes, serve to limit and control the spread of infection which would occur without them, and thus they become true disinfectants, though in the proportions used they may not be germicide, or by preceding the germs may have none to kill.

A very large number of chemical substances appear to be actively disinfectant in this sense. Selections from them are generally made for such uses in proportion to their activity and low cost, and thousands of experiments are on record attesting their efficacy and comparative value. If any of these antiseptic substances or antiferments be added to filth in proportion sufficient to prevent or arrest the septic processes or fermentations until the filth dries up, or is washed away, it serves the purpose of a true disinfectant, though it may not kill a single germ among the millions, dry germs being harmless and being destroyed in vast numbers by natural causes.

In this kind of disinfection the chlorides and nitrates appear by long experience to be most effective. The time when chloride of sodium was first used as an antiseptic is probably prehistoric, and the same may be said of some organic substances of the aromatic series. The antiseptic and disinfectant properties of smoke are probably almost as old, although the same agency has been investigated only within the past twenty years in the phenols or carbolic acid class of substances.

As infection is a very delicate, sensitive process, partaking much of the nature of a fermentation in being almost as easily prevented and arrested, so the substances which prevent or arrest it are very numerous, and usually effective in small proportion under definite conditions. It is like fermentation also, in that it appears to be caused by matter in a state of internal tension, which, under favorable conditions, enters into molecular commotion and change, multiplying itself and splitting matter around it into new forms which did not before exist. Hence it happens that two distinct classes of substances are applicable in treating it. And here, again, the one class destroys the infecting substance, while the other class so modifies the material to be infected that it is no longer susceptible to infection, and the result is practically disinfection in both cases or in two ways.

If infective matter is to be destroyed, whether it be in its quiescent state of readiness to infect, or in its active state of multiplication and extension,—it is found to be most sensitive to agents which like itself are in a state of tension and proneness to split up. For example, all chlorides are disinfectant, but those which in reacting with organic matters are reduced from a state of tension to a state of equilibrium or rest, appear to be most active. It seems probable that mercuric chloride in reacting with infectious material is reduced to mercurous chloride, both the free chlorine and the reduced salt entering into new combinations with the infection. Hypochlorites of calcium and sodium, and all other hypochlorites, are in a state of tension, and prone to split into chlorides and free or available chlorine. But it is doubtful whether this available chlorine is ever really free. It is merely freed from one base in the act of combining with another, exerting its maximum power in the process of changing bases. Chlorides of iron and zinc are both excellent disinfectants, and both when in dilute solution are ready to split into basic and acid combinations in the presence of organic matters with which they unite. Ferric chloride is especially prone to split in the presence of dilute solutions of organic matter. The effect of this chloride in small proportion upon sewage water is most remarkable, disinfecting and deodorizing it very completely, and leaving neither its iron nor its chlorine in the liquid unless used in excess. This remarkable effect was noticed many years ago by Dr. B. F. Craig, of the U. S. Army, upon the turbid waters of the Mississippi river, a few drops of a moderately strong solution being sufficient to clear a gallon of the water without leaving in it any greater proportion of either chlorine or iron. That is, both elements of the split went down with the precipitate caused or facilitated by the new combinations.

The intended drift of all this is to suggest that there are two distinct methods of disinfection which should be applied together, but which are still entitled to be considered separately, because they may be, and often have to be practiced separately, especially when epidemic forms of infection are to be prevented or combated. The one method is to destroy the infection, and the other is to change its pabulum from a condition of susceptibility to one of insusceptibility, wherein infection becomes more or less inoperative and harmless. The ideal normal condition of health does not admit of infection in any form, and therefore as the the natural laws of health are obeyed or broken, infection will be less or more common, and less or more virulent.

THE PRICES OF DISPENSING PHARMACISTS.

In estimating the prices at which articles of low cost, such as Disinfectants, reach the consumer, at pages 807 and 812 the writer had chiefly in view to show the proportion between the prime cost of such articles in bulk, and their cost when properly put up to prevent deterioration, and to be in convenient form for application or use. The details given showed the manufacturer's profit to be about 10 p.c., or say 1.54 cents on a bottle of disinfectant which cost 15.38 cents ; and showed that the wholesale dealer's profit should also be at least 10 p.c. not only on net cost, but on cost with freight breakage, packing expenses, etc., added, or say 2.2 cents per bottle on an article costing 17 cents. Then follows the statement that the dispensing pharmacist must have a much larger profit than the manufacturer and wholesale druggist together, and should have at least 5 or 6 cents per bottle.

A correspondent complains that in the latter statement full justice is not done to the dispensing pharmacist, because details are given to show the data of the smaller profits and why they are sufficient, while no details and but partial reasons are given for the double profits of the dispensing pharmacist, thus tending to increase an already existing prejudice against the charges of this class of dealers. As there was no intention to be either unfair or ungenerous to this class, nor to join in the charges of extortionate prices made against them, it may be well to try to show some reasons why they must have larger profits than either manufacturer or wholesale druggist.

The details of average cost of a dispensing business in a city or town of good size are difficult to get at, because inquiry into private affairs is impertinent and would not be likely to elicit the truth. But the correspondent, who is a dispensing pharmacist, supplies some details, while others are estimated from a standpoint of considerable information and some experience.

A moderate dispensing store may be estimated at a rental of $300.00 to $400.00 a year, say $1.00 a day. The furniture and stock of such a store would cost say $4,000.00. Interest on cost of this at 5 p.c., say 60 cents per day. Lights, fuel, water, insurance and taxes, say 70 cents per day. Wear and tear, breakage and repairs needed to keep the furniture and fixtures up to their value, say 30 cents per day. The sum of these estimated expenses is $2.60 per day. A competent assistant, who is a graduate of pharmacy, should not receive less than $2.00 a day, and an apprentice and errand boy 50 cents a day, making a total daily expense of $5.10. If the sales from such a pharmacy be say $20.60 a day, the purchases needed to

keep up the stock could hardly be less than $10.00 a day. Then if the purchases be $10.00 and the sales $20.00 the gross profit is 100 p.c. But the expense of selling for $20.00 what cost $10.00 is 5.10 or 51 p.c., leaving a net profit of 49 p.c. or $4.90 a day, which is less than 25 p. c. of the sales, although it be 49 p. c. on the supposed purchases. This $4.90 a day or $1,800.00 a year, is the total product of a man whose position is a very responsible and important one to the public around him, and to the physicians for whom he dispenses. His average history is, or should be, that he has served an apprenticeship of not less than 4 years, at an income of from 50 cents to $2.00 a day. Has had an education, both primary and professional, which is rather expensive in proportion to his capacity to earn, and has graduated from some school of pharmacy. Has next served as assistant for two or more years, or for as many years as was needed to gain a reputation and an expert skill at his calling, which has enabled him to obtain the position of a proprietor. By this time he has a wife and children to support, and the social expenditures of his station in life. Under these circumstances it must be admitted that he is not overpaid, nor fairly chargeable with extortion in prices, even when he makes 49 p.c. on his purchases.

But this 49 p.c. is only an average profit. Upon a prescription, the materials of which are almost without prime cost,—often only two or three inexpensive ingredients, with a large proportion of water or other cheap solvent or vehicle,—he is reasonably entitled to a far larger profit than the 49 p.c., because the value of all prescriptions, as well as all medicinal preparations sold, is not in the material, but almost entirely in the expert knowledge and skill with which they are prepared and dispensed. A pound of corrosive sublimate or an ounce of a strychnia salt, though not of high cost, if valued by their power to do good or harm, become of enormous importance to the community around them, and this value they get from the knowledge and skill with which they are dispensed. Hence a prescription, or a domestic remedy, does not get a tithe of its value from the materials which compose it, but is valuable almost solely from the knowledge and skill which enters into its composition. Hence instead of saying that a pharmacist makes 500 p.c. on a prescription for which he charges $1.00, and the material of highest prime cost in which may be a 5 cent vial and cork, it is much more fair and rational to take into consideration the worth of the educated skill and accuracy, and the moral honesty and fidelity which should go into all of the fifteen or twenty prescriptions of every day from that pharmacy.

But while the pharmacist is legitimately entitled to charge for

his cultivated knowledge and skill, as being by far the most costly as well as the most valuable item in this kind of dispensing, he must admit that this element is absent from a very considerable part of his business, and that unless he makes a discrimination in his charges he is liable to just criticism and obloquy.

For example, take the now prevailing fashion of using the ready-made coated pills of the large manufacturer,—which fashion is said to have diminished the prescription business by 25 p.c.,—if the pharmacist charges a profit upon these as though he had carefully selected the ingredients for quality, knew them to be compounded with accuracy, and made up with the skill to which he has been specially educated, he subjects himself to a just charge of extortion, and the moral delinquency taints his whole business. His position becomes that of having reduced himself to the grade of the small shop-keeper who simply buys at one price and sells at another, and therefore, he is only entitled to the shop-keeper's profits, while extorting from his customers the price of expert professional skill. In other words, in handing over his counter a bottle of coated pills or a bottle of disinfectant solution, neither of which he has himself made, he is entitled to no more profit than he is upon a tooth-brush or a cake of soap, because his educated skill as a pharmacist is of no value to his customer. On the contrary, his assumption of professional character may be a positive loss to his customer if he sells those pills and disinfectants which he can buy at lowest cost, and therefore, make most money on.

The dispensing pharmacist is therefore entitled to large profits just in proportion to the professional expert knowledge and skill exercised upon his calling. If he puts up a prescription he is justly entitled to a liberal reward for always being able and ready to do it, —night or day, Sunday or week day,—whether he has few or many to put up, for this is his legitimate work, and involves grave responsibilities. But when he sells somebody else's pills or disinfectants he is only entitled to common mercantile profits, and this entirely irrespective of the smallness or largeness of his business, or of its heavy or light expenses, and such mercantile profits can never fairly exceed 15 or 20 p.c., even upon articles of infrequent demand.

But perhaps the most important element in the prices of the dispensing pharmacist has not yet been alluded to here, namely, the smallness of his business. An establishment whose sales amount to $20.00 a day, could with little if any increase in general expenses, sell $40.00 a day, with all the advantage of fresher supplies, and thus prices could be materially reduced and profits as much increased,—and every good pharmacist's efforts are constantly strained

in this direction. The reason why such efforts are commonly unsuccessful, except by the very slow process of reputation based on superior ability, exercised with scrupulous moral integrity and care, is very easily recognized in the constantly increasing number of these establishments. The number being so greatly in excess of the need for them the business of each must necessarily be small, and therefore the profits must be large. Of the very large number of these pharmacies, the more shrewd and energetic proprietors soon learn to disregard the rarely arriving prescriptions, and cultivate rather the more fertile soil of the popular taste for fancy goods, fancy drinks, fancy foods, patent medicines, cigars, etc.

As one after the other of these elements is introduced into the more legitimate business of the pharmacist he becomes more and more of a merchant, and has less and less time for the cultivation of his special art. Reducing prices and increasing profits become his absorbing aims, and as he accumulates the means he multiplies his places of business, until his stocks of castile soap, his barrels of cheap quinine pills and his flaunting placards are rarely out of sight. Of course such can sell their wares at lower prices than their slower neighbors,—not only because they may be of poorer quality, but chiefly because their business is not $20.00 a day, but often more than five times that, while their expenses may not be double those of the smaller business.

From all this it would be natural to infer that the thoughtful physician and the thoughtful father of a sick child would hesitate to join in the popular crusade against the high charges of the dispensing pharmacist, but would rather seek to discriminate in favor of superior expert knowledge and ability in their important selections, and be willing to pay well for this even on the selfish ground of trying to secure it in perpetuity against the inroads of cheap merchandising.

A very able and conscientious pharmacist once told the writer that he could scarcely live by his business, because the prominent New York physicians would only send him the few of their prescriptions which involved the most responsibility with the least profit. He, however, maintained the courage throughout his career, now ended, to keep up his standard and keep out all other kinds of business. The result was that after a few years of struggle, dominated by self-control and self-denial, the reward came with the certainty of an inevitable natural law, and he enjoyed many years of very enviable prosperity. One peculiarity grew upon his business. His customers went to him because his charges were high,—at least so they thought. But they really went to him because his habits of

conscientious care and his great ability became gradually better known by experiencing them, and there are classes of people who are so willing to pay for these that his high charges were tacitly admitted to be for his skill and integrity rather than for his materials, and were therefore cheerfully accepted. The class which grew around this man's life, and around very many others like him, never thought of how much they were paying for a little water in a prescription of only two or three items, but very often thought, with a satisfaction that serious illness brings to the watchers, of the reliance that was due to a high order of skill and moral integrity when combined in the interest of human suffering.

THE MARKET FOR COCA AND COCAINE.

Since the last note on this subject, the arrivals of coca in the New York market have been frequent, many of the lots large, and the quality generally good. The subject has been so freely discussed and so much information has been obtained through public and private channels, that there is probably now no reason to fear either a scarcity or very inferior quality, but the fear now is rather that the market should be overstocked and prices fall so low as to cause a future reaction. Almost all the samples seen were of fair quality, and a majority of them were of very good quality. Several assays of different lots gave proportions of alkaloid varying between ·38 and ·55 p.c., four shipments at least yielding the latter high proportion. As there are 7,000 grains in an avoirdupois pound, it is only necessary to multiply the percentage yield of alkaloid by 70 to get the number of grains of yield to the pound of coca. Thus $·38 \times 70 = 26.60$, and $·55 \times 70 = 38.50$ grains to the pound. Although this is the actual yield of cocaine from the leaves, the available yield is so far considerably less, through losses in the purification processes not yet avoidable. A coca which yields 38.5 grains of alkaloid to the pound should—according to the formula given in Gmelin's Handbook, Cavendish edition, vol. XVI., p. 302,—yield (As 88.78 : 100 :: 38.5 :) 43.36+grains of the hydrochlorate; but although such coca has been worked, no such yield has been realized by the writer, and it is rather discreditable to have to say that not over 33 grains to the pound has yet been reached, and this not as a general average. Still, as details in the management are constantly being improved, there can be no doubt that better practical results will be reached by experience.

It seems altogether probable that the quality of the coca now in

the market is as good as can be expected, and therefore that the assays indicate about the highest figures that will be reached, and as the supply is very abundant this important part of the subject is satisfactorily settled.

Prices have also declined very much and still tend to decline. Several holders of large lots which had cost them 90 cents to a dollar a pound managed for a time to keep the prices reasonably near to their cost, but they failed to sell, and now must suffer heavy losses. As the prices declined and arrivals multiplied, several lots were sent abroad, thus relieving the market temporarily, but still excellent lots were always accessible at prices constantly falling. On June 19th a lot of good quality was sold at auction at 52 to 55 cents, and after that there was a good deal of uncertainty as to where the price was, the constant effort of the importers being to keep it up, but with a very limited demand, and an unsafe condition for speculation. Only the importers know what the article really costs them in South America, but it seems not unreasonable to suppose that it can be sold here at fair profits for about 32 to 35 cents per pound for those grades which are best for making the alkaloid. The more carefully cultivated grades appropriate to making the fluid extract of good quality must cost more. No such prices have yet been reached, and no one knows when they are to be expected, but it is fair to assume that good coca giving an available yield of hydrochlorate of 33 grains to the pound can now be had (June 29) at 50 cents per pound.

If, then, the cost of the process of extraction be, as given at page 732, about $1.20 per pound of coca, the cost would be (50+1.20=) $1.70 for 33 grains of the salt, or but little over 5 cents per grain. The vial, label and overweight in putting up would probably bring the cost up to 6 cents per grain, or a little more. Such articles are not worth making unless the profit upon them be liberal, especially until the losses in acquiring a good process be fully compensated; therefore, the salt should now bring at least 10 cents per grain under the present very favorable conditions.

Under these conditions of market the writer, about June 15th, decided to reduce his price for hydrochlorate of cocaine, on July 1st, to 10 cents per grain, thus getting it at once down to as low a price as it will be likely to reach in his hands, so long as the heavy tax of this country applies to alcohol and ether, and no less expensive solvents are applied.

This price, however, will certainly be low enough to enable the uses of the substance to be greatly extended.

DISINFECTANTS.

It will be seen by the correspondence of the *Medical News*, of Philadelphia, of June 20th, page 704, that the International Sanitary Conference at Rome, Italy, has decided to confine itself to the subject of the prevention of cholera until that be disposed of, and then, if there be time and a disposition to discuss them, other diseases may be taken up.

A committee of seven was appointed to consider the subject of disinfection, with Dr. Sternberg, the U. S. delegate, named first; but, upon his proposition, Dr. Koch was made Chairman.

After several protracted sessions the committee made a long report, which was adopted by the Conference by a vote of 20 to 1.

The Conference, therefore, recommends, as means of disinfection against cholera:—

"1. Steam at a temperature of 100° C. (212° F.).

2. Carbolic acid. Chloride of lime.

3. Aëration.

Carbolic acid and chloride of lime are to be used in aqueous solution:

Weak solutions: Carbolic acid, 2 per cent.: chloride of lime, 1 per cent.

Strong solutions: Carbolic acid, 5 per cent.; chloride of lime, 4 per cent.

These means of disinfection will be applied as follows:

I. For the disinfection of person the weak solutions should be employed.

II. For the disinfection of clothing, bedding (*des linges, des habits, des couvertures*) and other articles of this kind:

(*a*) destruction: (*b*) steam passed through the articles for one hour; (*c*) boiling for thirty minutes; (*d*) immersion for twenty-four hours in one of the weak disinfecting solutions; (*e*) aëration for three or four weeks, but only in case the other means recommended are inapplicable.

Articles of leather, such as trunks, boots, etc., should be either destroyed or washed several times with one of the weak disinfecting solutions.

III. Vomited matters and the dejections of the sick should be mixed with one of the strong disinfecting solutions, in quantity at least equal to the amount of material to be disinfected. Linen, clothing, bedding, etc., recently soiled by the dejections of the sick, which cannot be immediately subjected to the action of steam, should be at once immersed in one of the strong disinfecting solutions, and left for four hours.

IV. The dead should be enveloped in a sheet saturated with one of the strong disinfecting solutions, without previous washing of the body, and at once placed in a coffin.

V. Disinfection of merchandise and of the mails is unnecessary (steam under pressure is the only reliable agent for the disinfection of rags—*les chiffons en gros*).

VI. When cases of cholera occur upon a vessel at sea, the locality where the case occurs should be disinfected. The floors and walls of the cabin, or other locality, should be washed at least twice with one of the weak disinfecting solutions, and then exposed freely to fresh air.

In the case of objects of considerable value, which have not been in immediate contact with the sick, and which would be seriously injured by a rigorous disinfection, the physician on board may determine what measures are necessary to protect the sanitary interests of the vessel.

The bilge-water should be pumped out, and replaced by sea-water, at least twice at each disinfection of a vessel.

The *closets* should be well washed with one of the strong disinfecting solutions at least twice a day.

VII. If the drinking-water is open to suspicion, it should be boiled before it is used, and the boiling should be repeated, if it is not used, within twenty-four hours.

All suspected food should be destroyed, or at least recently cooked.

VIII. Hospitals should be disinfected by washing the floors and walls with one of the weak disinfecting solutions, by a subsequent free ventilation and cleansing, and finally by repainting. The wards to be disinfected should, as far as possible, be isolated from those in use.

The latrines should be disinfected at least twice a day by pouring into them the strong disinfecting solutions in quantity at least equal to the amount of the dejections received since the last disinfection.

IX. The clothing worn by physicians and attendants should remain in the hospital, and should be regularly disinfected.

Physicians and attendants should use the weak disinfecting solutions for washing their hands, etc."

It will be noticed by this quotation from the correspondent of the *Medical News*, that so far as cholera is concerned, the Conference does not agree with the conclusions of Dr. Sternberg's committee here, in omitting carbolic acid as not being a true disinfectant, but, on the contrary, places it first in rank, as taking precedence in value over chlorinated lime, and this appears to have been done upon the experience of Dr. Koch. This delegate objected to recommending corrosive sublimate, for two reasons: First, because it was too dangerous for general use; and, second, "because, its disinfecting action was, to some extent, interfered with by the fact that it entered into combination with albuminous material, and thus failed to come in contact with germs enclosed in albuminous masses."

Dr. Koch's first objection appears to be more sound than his

second one, since it is highly probable that all germicides act by combination with the albuminous material of the infective matter.

Only two chemical disinfectants were recommended, not because there were none others trustworty, but because it was sufficient to recommend two of those most generally useful. Indeed, Dr. Koch seems to have considered carbolic acid alone sufficient, but in deference to the work of the Committee on Disinfectants of The American Public Health Association, made no objection to including chloride of lime with carbolic acid in the recommendation, upon the representations of Dr. Sternberg.

The aqueous solutions of carbolic acid here recommended are very easily made from either the officinal crystallized Carbolic Acid, or from good impure carbolic acid or coal-tar creasote. When made from the latter they will be better disinfectants, but the odor is much more disagreeable.

To make the Solutions from the crystallized acid, or Phenol, the one pound bottle of cyrstals should be melted by setting it in warm water. A fluidounce of water should then be added and the contents be shaken. This will serve to keep it fluid. Then the solution is made as wanted. For the 2 p.c. solution 2 measures to 98 measures of water will be sufficiently accurate, and for the 5 p.c. solution 5 measures to 95 of warm water. The solution of this proportion in cold water is a little tedious, but by the use of warm water it dissolves at once.

For continuous use about infectious cases it is only necessary to keep the strong solution, and a half gallon bottle can be conveniently made at a time by putting about $3\frac{1}{4}$ fluidounces of the fluid acid in the bottle, filling with warm water, and shaking well. This may be repeated as often as required, and a pound bottle of crystals, or of the impure acid will thus make about $2\frac{1}{4}$ gallons of the strong solution.

When the weak solution is wanted it may be made from the strong by adding to each measure of it $1\frac{1}{2}$ measures of water. That is, one bottle of the strong solution will make two and a half bottles of the weak.

This weak solution is quite benumbing to the skin if applied for any considerable length of time.

THE PHARMACOPŒIA OF 1880.

(Review Continued.)

ATROPINÆ SULPHAS.

SULPHATE OF ATROPINE.

[ATROPIE SULPHAS, *Pharm.*, 1870.]

$(C_{17}H_{23}NO_3)_2H_2SO_4$; 676. — $C_{34}H_{23}NO_6.HO,SO_3$; 338.

A white, indistinctly crystalline powder, permanent in the air, odorless, having a very bitter, nauseating taste, and a neutral reaction. Soluble in 0.4 part of water, and in 6.5 parts of alcohol at 15° C. (59° F.); very soluble in boiling water and in boiling alcohol; also soluble in 0.3 part of absolute alcohol. When heated on platinum foil, the salt is decomposed and wholly dissipated, emitting acrid vapors. On adding test-solution of carbonate of sodium to a concentrated, aqueous solution of the salt, a white precipitate is obtained which answers to the reactions of Atropine (see *Atropina*). An aqueous solution of the salt yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid.

The Sulphate of Atropine of two makers only could be identified in this market as supplying almost, if not the entire demand for the salt, and both makers were foreign, the entire supply being imported. Both were white, but only one was crystalline; the other, even by the aid of a good glass, appeared to be amorphous. Although equally white in appearance, the one made a solution that was nearly colorless, while the other gave a solution of the color of sherry wine. Their solubilities were practically the same.

One part of the salt with ·4 part water at 15° C. gave a pasty mass too thick to be shaken, and when stirred for half an hour at the temperature, showed no signs of solution. Farther additions of water, ·1 part at a time, with stirring, shaking and digestion between the additions, failed to give a complete solution until ·8 part was reached. This did not give a complete solution within a half hour, but after standing over night the solution was complete. Whether the temperature of the bath arose a degree or two during the night is not known. A new mixture of equal parts of the salt and water at 15° C., gave a transparent solution that was complete after 5 minutes' shaking.

Six grammes of the commercial sulphate most commonly used was soluble in 5 c.c. of water at 20.6° C. with 20 minutes' active agitation. This solution diluted to 50 c.c., and precipitated by excess of solution of sodium carbonate gave a crystalline precipitate which, dried at 100° C., gave 3.210 grammes of atropine. The mother-waters washed 8 times with 10 c.c. of chloroform each time gave 1.548 grammes more of atropine, making a total of 4.758 grammes of atropine from the 6 grammes of sulphate. It will be seen that nearly one-third of the alkaloid was held by the mother-

waters. According to the formula given by Gmelin, the 6 grammes should have given 5.130 grammes of alkaloid; but it gave ·372 gramme, or 7.25 p.c. less, which is a heavy loss.

The solubility in alcohol varies very much with slight differences in the strength of the alcohol. When of a s.g. of ·814 at 15.6° C., alcohol dissolves the salt with a proportion of about equal parts at 15° C.; but when of the officinal strength of ·820, one part of the salt is not completely soluble in less than 8 parts of the alcohol. Then in weaker alcohol the salt becomes again more soluble, but the point of least solubility was not determined.

Unfortunately there are no tests of purity given for this salt, and the writer knows none, but its importance in the materia medica certainly demands that it should be critically studied and controlled by pharmacopœial authority. A physiological test may be practicable, and this point will be investigated under the head of Belladonna.

It is largely used in solution, and two strengths are commonly required,—one of 2 grains in the fluidounce, and the other 4 grains. Their strengths are equal, respectively, to ·130 and ·260 gramme in 30 grammes of solution, or about 1 part in 231. These solutions are very liable to be spoiled by the growth of confervæ, and always require some protecting agent to prevent these growths, as the microscopic plants are nourished at the expense of the alkaloids, and the solutions become rapidly weaker.

In the Proceedings of the Amer. Pharm. Asso. for 1873, Vol. XXI., page 589, a paper upon this subject by E. H. Squibb will be found, wherein it is shown that the addition of one-sixth of one per cent. of carbolic acid effectually protects these solutions against these growths. This proportion is reached by the presence of 15 minims of a 5 p.c. solution of carbolic acid in each fluidounce of the solutions.

Carbolic acid was thus used as a protection for about 4 years, and large quantities of solutions of this and other alkaloids were dispensed without any known failure to protect, and specimens of such solutions now over 10 years old show no signs of microscopic growths. During this time, however, there were many objections made to carbolic acid, on account of its alleged irritant properties, and on account of the odor. There could have been practically no irritation from this very small proportion, but the objections to the odor, though of little importance, were better founded, and therefore salicylic acid was adopted instead of carbolic. It was found by experiment that just about the same proportion of salicylic acid protected the solutions quite as effectually as the carbolic, and were free from odor. But if there had been any irritation from the one

agent, there could certainly be no less from the other. A cold saturated solution of crystallized salicylic acid, made by dissolving 2 parts of the acid in 500 parts of warm distilled water, and allowing the solution to become cold, and deposit the excess of acid,—was found to contain just about 1 part of acid in 300 of solution. The sulphate of atropine was dissolved in distilled water and the solution filtered, and the filter washed through until the solution was just double the desired strength, and then an equal volume of the solution of salicylic acid was passed through the same filter until the desired strength was reached. This gave to the solutions about $\frac{1}{600}$ of the salicylic acid. Solutions of sulphate of atropine thus protected have now been dispensed in large quantities during about six years without any known failure to protect, and without any complaints of irritation, and of course none from odor. But salicylic acid is an irritant when in sufficient quantity, and in using the formula just given, to protect solution of cocaine salts, the question has arisen as to whether the primary irritation of cocaine is not increased slightly by even the very small proportion of the salicylic acid, and if it be increased in cocaine solutions it would also be increased in those of atropine, and then, if there be a protecting agent which is unirritating, it would be wise to adopt that in place of the salicylic acid. Boric acid is not only unirritating, but is positively sedative to mucous membranes, and is at least neutral or passive in hypodermic injections, and it is an active antiseptic and seems to prevent the growth of these confervæ, but it is required in much larger proportion than either carbolic or salicylic acids. A series of experiments are now in progress for protecting cocaine solutions with boric acid, and the results as applicable to cocaine solutions have been reported in these pages. If applicable to cocaine solution it will, of course, be equally applicable to those of atropine.

The solution of sulphate of atropine most commonly used is the 2 grain solution, meaning 2 grains in the fluidounce of 456 grains or 480 minims, and if such a solution now commonly used, could be universally adopted much confusion and many mistakes would be avoided. The solution is nearly ·44 p.c., and each fluidrachm of it contains a quarter of a grain of the salt,—30 minims the eighth of a grain, and 10 minims the twenty-fourth of a grain. About 4 minims of this solution, equal to a little more than ·001 gramme of the salt, is regarded as the maximum adult dose to begin with, this being given at shorter intervals rather than increased in quantity, until the desired effect is reached. A very convenient way of administering the salt is to put 30 minims of this solution into a wineglass and add to it 7 teaspoonfuls of water. Then, using the same

teaspoon, each teaspoonful will contain 4 minims, and the solution will be sufficient for two days of three doses each day. As the effects are recognized the dose can be easily reduced by adding one or more teaspoonfuls of water to the quantity remaining. Minim pipettes are, of course, more accurate for such solutions, and nowhere does accuracy of administration make the difference between success and failure more frequently than in the use of such agents as this.

For internal use and also for external application the fluid extract of either the leaf or root of belladonna is preferable. But it is perhaps most frequently given hypodermically, and then the 2 grain solution is alone applicable. In no active agent is the range of dose by hypodermic injection so great, and this range seems to be greater when used hypodermically than by the stomach. The maximum hypodermic adult dose to begin with seems to be not 4 minims of the 2 grain solution, but 5 or 6 minims in ordinary use, and 8 to 12 minims are often required and used in extraordinary cases. Yet not unfrequently the most minute doses are very effective. For example, when used as an antidote to nux vomica or Calabar bean large doses are required, but as an antidote to jaborandi and muscarine very minute quantities seem to be effective. As an antidote to opium and morphine much care is needed, since it occasionally at least seems to have increased the toxic effects and hastened the fatal results.

For the relief of pain belladonna and atropine rank with opium and morphine, and in both agents the dose is to be carefully regulated to the amount of pain or spasm to be overcome.

Three very characteristic effects follow the administration of atropine with a promptitude proportionate to the size of the dose and to individual susceptibility. Dilatation of the pupil usually occurs first, then dryness of the fauces, and next increase of the pulse rate. The first of these effects is occasionally very prompt indeed, the writer having seen marked dilatation of pupil occur within 15 minutes after the application of 30 minims of fluid extract of belladonna to a painful knee.

Although a very powerful agent, exceedingly prompt in action, it is remarkable that very large doses are often followed by prompt recovery. Cases are recorded in which various large doses from half a grain to a grain and a half of the salt have been taken without fatal effect.

A very valuable life was recently lost in this city by the accidental misunderstanding of a badly written prescription for sulphate of atropine. The physician wrote for 1.5 millegrammes of the salt in 30.0 grammes of water, to be used as directed. The

pharmacist put up 1.5 grammes of the salt in 30 grammes of water, and the patient, suffering with facial neuralgia, took, by a supposed verbal direction of the physician, a teaspoonful dose of this solution with fatal effect in about 20 hours, though aid was promptly obtained and everything was done that skill could suggest and persistent effort accomplish. The fatal dose in this case was about 2.89 grains, equal to ·1875 gramme of the salt, or 694 minims of a 2 grain solution.

There are three points not easy to understand on the physician's side of this unfortunate case, when seen from the prescription table of the pharmacist, on the supposition that to the latter the prescription was ambiguous or doubtful. First, could a physician really mean so small a quantity as a forty-fourth part of a grain of sulphate of atropine in a fluidounce of water? If he really meant this, how could he expect so small a quantity to be weighed with any useful degree of accuracy on any ordinary or extraordinary prescription scale; and finally, why did he adopt the unusual notation of a decimal point that is no part of the metric system where he placed it, but is a very important element in its proper place? If the unity standard of the metric system was a millegramme then his notation would have been good, but the unit is the gramme, and all smaller quantities are decimal fractions of a gramme, and require a decimal point before them. Nevertheless, arithmetically his expression could mean only one and a half millegrammes, and could rationally be construed in no other way. Had he written ·0015 gram. there could have been no mistake, because this is the proper and usual notation, and the pharmacist would simply have had to decline the prescription unless he had an inclosed analytical balance to weigh it on. He might, it is true, have multiplied the quantities by 10 and thrown away nine-tenths of the solution. But instead of that he seems to have jumped at the conclusion that the solution was for external application,—though from 6 to 11 times stronger than any he had ever dispensed for any external use.—and thus sacrificed a human life, instead of referring the prescription back to its source. He appears really to have suspected no mistake either on his own or the physician's part, and, however well educated, he was wholly incompetent for the post he filled. It is, perhaps, the most unfortunate part of such occurrences that the incompetency, whether of physician or pharmacist, or both, is not discovered until the mischief is done. The schools have graduated both, and, having thus pronounced them competent, the law sets them up as fit to exercise their professional skill for the public good. But when, in the exercise of this skill, they prove incompetent, those who employ them are always the first to suffer, and suffer most.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. SEPTEMBER, 1885. No. 11.

ADMINISTRATION OF MEDICINES.

Next to quality in medicines the most important consideration is a fair degree of precision in quantity and mode of administration in their relation to the desired or expected effects. The quantity or dose is based partly upon the physiological effect of the agent upon the normal or healthy condition, but mainly upon that condition as modified by disease or disorder, and this as again modified by varying idiosyncrasy or susceptibility. The quantity is again modified in a very important degree by the effect desired, and the effects known to result from variation in quantity, and thus the whole question of quantity is brought to depend upon experience. Knowledge of the ultimate constitution and physical properties of the agents used in various quantities upon the healthy human organism is of great importance; but experience of the effects in disease, which in most instances preceded this knowledge, is of still greater importance, and often, in its relation to both quantity and effect, sets this knowledge at naught. For example of this it is only necessary to recall the quantity of opium tolerated with benefit in conditions of extreme pain, which would be fatal in conditions of health.

This much will perhaps be sufficient to emphasize the importance of a fair degree of precision and accuracy in quantity or dose, and mode of administration, and justify the stress laid upon what is to follow.

Probably no greater degree of accuracy has been obtained in practice with medicinal agents than when the substances were, as in the earlier days of the medical art,—taken in weighed quantity,—"steeped" in a measured quantity of solvent, and the strained so-

lution divided into a prescribed number of doses, and given at prescribed times. But as then most of the agents were from the vegetable kingdom, and, taken in a fresh state, their very variable efficacy as taken at different seasons of the year, and in different conditions of succulency from the presence of more or less water in the leaves, flowers, barks or roots used, must have soon become matters of experience, and must doubtless have led to the collection of the desired part of the plant at the proper season, and of the drying and preservation of this part for more effective and uniform use throughout the whole year. This step in advance seems, on the authority of Richardson and other good etymologists, to have been the origin of the word "drug," from a word signifying "dried;" and from this the word "druggist," whose art it was to collect, dry and preserve the medicinal substances for use at all times. In the use of infusions and decoctions, whether from fresh or dried plants, it must have been soon discovered that they did not keep longer than a day or two, and that the changes which rendered them useless were of the same character as the fermentation of their fruit juices which gave them wines; which wines then remained without farther change for indefinite periods. This would naturally lead to the "steeping" of the fresh or dried substances in wine, and afterward, in time, to the more systematic making of tinctures or solutions in "spirit of wine." In these would be found a class of much more uniform and stable preparations, ready for instantaneous use at all times, and in doses much smaller than the infusions and decoctions; and it would also soon be discovered that these solutions were more stable than the dried substances, and more easily preserved. Thus the effective doses may have been reduced from such a volume as a pint or half pint to a wineglassful; and in the progress of farther experience as wines were replaced by spirit of wine, the tinctures would be still farther concentrated until corresponding doses would be reduced to be measured by volumes such as tea and tablespoons. Next in natural progress would be the evaporation of these tinctures to obtain extracts; and from these extracts would come processes to separate their more active parts, and finally the active principles, and these differentiated into acids, alkaloids, glucosides, etc. In this natural progress, however, two important facts have been recognized and established by experience. First, that the active principles, though far more active in general, and far more applicable to certain uses, do not always, if ever, represent the full effect of the organic substances from which they

come ; and that where they differ materially, as in opium from morphine, or nux vomica from strychnine,—the practical result to the critical observer of effects has been the possession of two agencies from the same source.

The second important fact recognized by this progress is that the liquid or fluid condition of medicinal agents is the most certain, the most prompt, and the most effective form in which they can be uesd. No one thinks of depositing a hypodermic dose of any substance in the solid condition, yet comparatively few seem to remember that in diseased conditions the stomach and small intestines are in a condition which may differ only in degree from the subcutaneous tissues, in relation to solids brought in contact with their surfaces. It is beyond question now that a pill, coated or uncoated. hard or soft, and of however active ingredients, may be passed into a stomach relaxed and empty from diseased conditions of the organism, with relaxed condition of the pyloric extremity,—with very slow and uncertain effects, or with no effects at all. The mouthful of water which carries it down may go at once into the vessels of the coats either by active absorption or by mechanical imbibition, but the pill or any other solid, even in a more loose condition, may slide passively over the glary mucus and get far down the canal, or entirely through it with a very slow solubility. Under such conditions it is very evident that the medicament should have been dissolved in the mouthful of water and gone with it promptly into the circulating fluids. Had the pill or solid substance had the stimulus of quantity to excite the peristaltic action of the canal, then, however enfeebled the stomach, there would be some degree of closure of the pylorus, and some churning motion or vermicular action by which solution and absorption would occur, but this is supposing a liquid or semi-liquid condition more or less closely analagous to the condition of food which is best adapted to the condition of an enfeebled stomach.

Physicians know well the appropriateness of liquid foods in disordered conditions of the passages, but do not always remember that their medicines had better be in the liquid form for the same reasons.

If now it be granted that the active principles of drugs do not always, if ever, represent the total effects of the drug, or the experience upon which the uses of the drug are based ;—and farther, that the liquid condition is that which is most favorable to prompt and energetic action, then a position of readiness,—or of demand is

reached for the still greater progress made chiefly through the investigations and results of Prof. William Proctor, Jr., of Philadelphia, in introducing the class of fluid extracts.*

Representing the entire drug with its active principles in their natural combinations,—fairly protected from change in keeping,—in the liquid condition in concentrated form ready for any degree of dilution,—and bearing the simple relation to the drug of a volume equal to its weight, this class combines all the advantages of infusions, decoctions, tinctures, extracts, and to some extent of active principles, and therefore is the best form yet reached for the administration of the medicines for which they are the complete and accurate substitutes.

The character of this step in natural progress is attested by the fact that they came rapidly into general use without any proprietary claims or any special advertising. The professions of medicine and pharmacy at once recognized their utility and value without having to be converted by the flaring advertisement, or the ubiquitous drummer, and now after more than 40 years of use, during which time they have also been much abused,—they have not only sustained and confirmed their high character, but have steadily displaced and replaced their inferior duplicates, the tinctures, which, in their time, had displaced the infusions and decoctions. As a form for the administration of the substances they so well represent, they leave little to be desired excepting improved accuracy in administration, and in the need for this they share with all other medicines in the liquid form.

Indeed solutions of active chemical salts often stand more in need of improved accuracy of administration than galenical preparations, especially when they are very potent, or when they are graduated in quantity to some special degree in effect, and it is the primary object of this note to discuss the mechanical means whereby accuracy in dosage and administration may be improved.

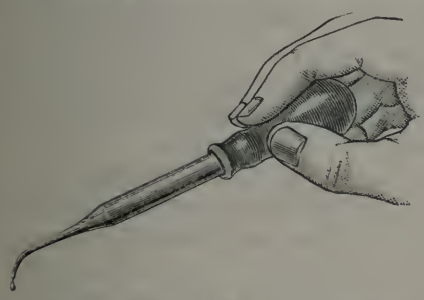
By far the most natural, the most simple and the easiest way of dosing medicines is to have them in a concentrated liquid form, and measure them by drops, and under uniform conditions of fluid and of vessel, dropping is sufficiently, though never absolutely accurate.

But liquids differ so much in specific gravity, in tenacity, viscosity, etc., that from these causes drops can only be accurate measures of quantity for a single given liquid, and will vary widely in different liquids. Again, drops even of the same liquid vary in size or quan-

* See American Journal of Pharmacy for papers extending through many years.

tity with every variation of size and shape of the orifice from which they are dropped, and also from the position in which the vessel is held, and from the head or pressure under which the drops are formed, so that it is not uncommon for the different sides of the mouth of an ordinary vial to give drops of different value or quantity when the vial is of the same degree of fulness ; and no part of any vial lip will give drops of the same volume from first to last when a full vial is emptied by dropping. Again, the drying of a liquid on the lip of a vial after once dropping, gives a slightly different volume to drops of succeeding droppings. Notwithstanding all this some of these elements of inaccuracy are so slight as to be unimportant, and there are many physicians whose habits of close observation and care enable them to reach a high degree of accuracy by dropping. Such physicians,—and it is hardly necessary to say they are the most successful therapeutists,—test each vial of their pocket medicine cases for the liquid it contains, by filling it with its special liquid, and dropping this into a good minim measure. If, for example, the vial holding fluid extract of aconite root delivers 150 drops into a minim measure to fill it to the mark for one fluidrachm, then the drops from that vial are 2.5 to a minim, and as a minim represents a grain of the powdered root, 2.5 drops of this liquid from this vial will represent the grain of powdered root. And so all the liquids of all the vials of a pocket case are tested, and the number of drops which represent a minim are marked upon each label.

Other physicians use the common "French Pipette." This inexpensive and simple little affair, as ordinarily sold, is of two forms, straight and bent. The point should look directly downward when the drops are delivered, and therefore the bent form is most convenient for use, although not the easiest to carry with safety in a pocket case. The bent form of this dropper is illustrated in the subjoined cut, of one-third the natural size, and in the position held in dropping. In filling, the rubber tip is compressed between the thumb and finger, to expel the air, and the point being immersed in the liquid the pressure is relaxed and the liquid drawn up. Care should be taken so to modify the pressure on the rubber tip as



French Pipette, or Medicine Dropper.

not to fill the glass tube to a point out of sight when the pressure is relaxed, because the inside of the rubber should never be wetted by the liquid. If wetted by some liquids it is soon softened and spoiled; but with any liquid it is more or less difficult to clean, and inspection can hardly determine whether it is clean or not, while the glass part is easily cleaned by slipping off the tip and running a little water or alcohol through it, and is easily seen to be clean.

This little instrument, costing only about 50 cents a dozen, is carried in the pocket case, and is tested with each liquid in the case. That is, it is filled once or oftener with each liquid, and the liquid is dropped from it into a correct minim measure, until the 30 or the 60 minim mark is reached. Then if 100 drops be required to measure 60 minims, as is commonly the case with water, 1.66 drops make a minim, while if 100 drops be required to make 40 minims then $(100 \div 40 =)$ 2.5 drops will measure a minim, as in the case of some fluid extracts,—and this equivalency is noted upon each vial of the case.

Physicians who use this French Pipette or medicine dropper often carry a vial of acohol to give it a second rinsing with, after having rinsed it with water.

Suppose a minim of fluid extract of aconite root, equal to one grain of the powdered root, be required to be administered to a patient every two hours during 12 hours of the interval of 24 hours between the visits of a physician. He calls for a wineglass, a teaspoon and some water, and measures into the wineglass 8 teaspoonfuls of the water, and then drops into this from his pipette $(8 \times 2.5 =)$ 20 drops of the fluid extract of aconite root, stirs well and directs a teaspoonful to be given every two hours, stirring well before each dose is taken out. He really needed only 6 doses, but to provide against accidents he makes 8, and has the 20 drops added, in excess of this. But quite that much will be lost by evaporation in 12 hours even if the wineglass be covered by a piece of paper, as it should be, the spoon being laid across the top, upon the paper.

Another still more accurate, more simple and easier way of dispensing or measuring minims is by means of a minim pipette. This little instrument was devised by the writer many years ago, and has made its way thus far without any description or explanation, until now many thousands are in use all over the country, and some physicians in the cities are beginning to prescribe them with their active medicines for family use. And many trained nurses are taught to use them. There is just one point in their management, however,

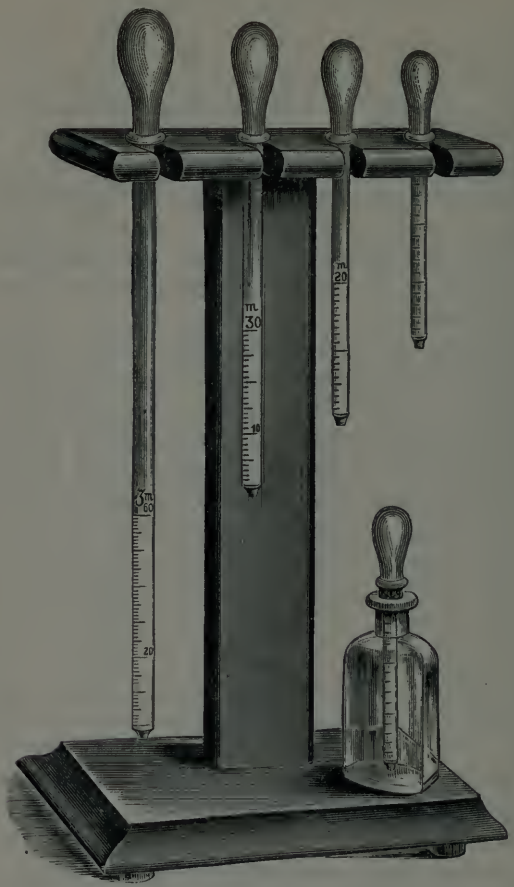
that is commonly not well understood, and which, not being understood, interferes with their intended accuracy in use.

This minim pipette is a straight, glass tube, graduated like a minim measure, only that it is graduated downward, while the minim measure is graduated upward. It is open at both ends, but contracted at the lower end to a short, rounded, blunt point not easily broken or damaged by falling upon the point. A much handsomer looking point was used for many years, but it was so often broken that the more clumsy looking one shown in the cut was substituted with success.

The upper end of the tube is fitted with a rubber tip which, when slipped on so far as to have the end of the tube in the middle of the bulb, has an air capacity fully equal to the graduated portion of the tube. Hence, when the rubber tip in place is compressed upon the tube between the thumb and finger, and the point is immersed in a liquid, if the compression be then relaxed entirely the liquid should rise to a little above the 0 point of the graduation. The final adjustment to the 0 point is then made by holding the pipette firmly with one finger and thumb, while with the other applied to the round projecting border at the lower end of the rubber tip, the tip is screwed or twisted downward upon the glass tube. As it is thus screwed downward the line of liquid in the tube will fall slowly and can be thus accurately adjusted to the 0 mark. The pipette is now charged to its exact measuring capacity, and if undisturbed will remain so indefinitely unless the temperature of the inside air should change. In order to deliver any required part, or the whole of this charge into a vial or other receiving vessel, the rubber tip is cautiously compressed until the required mark is reached, the remainder being transferred back to the stock bottle, by complete compression of the rubber tip. The tip is then slipped off, and the tube at once rinsed out with water or alcohol, or both in succession, according to the nature of the liquid measured.

These pipettes are made of four sizes, 15, 20, 30 and 60 minims, the three smaller sizes being sold at 20 cents each, and the larger at 30 cents. All are graduated with a fair practical degree of accuracy. That is, all are tested as they come from the graduator, and those which vary from accuracy more than two minims in the total graduation are rejected.

The smaller sizes are well adapted to the physician's pocket case, as well as to the dispensing counter of the pharmacist, but the larger one is only adapted to counter or office use.



SET OF MINIM PIPETTES.

SCALE ONE-THIRD LINEAR DIMENSIONS.

The 60 Minim Pipette is made very long for the purpose of measuring liquids from dispensary or office stock bottles, thus avoiding the pouring out of the liquids, and wetting the neck and lip of the bottle.

The 30 Minim Pipette is for similar uses with smaller bottles, while the two smaller sizes are used principally for measuring doses in the sick room, and for carrying in pocket cases.

The prescription vial shown upon the stand is to illustrate the arrangement most convenient for use when the Minim Pipette is prescribed with the medicine. The vial and prescription are dispensed corked as usual, the pipette being wrapped up separately. When they reach the sick room the cork is taken out, and replaced with the one through which the pipette passes.

The cut shows them in a little stand adapted to the use of the dispensary, whether of the pharmacist or physician. The stand is home-made, and of course may be varied to the conditions for use. Ordinarily no better stand can be made than some slits in the edge of a shelf.

These minim pipettes are well adapted to take the place of both the ordinary dropping tube and the minim measure. By their use the drops of various liquids are easily measured in minims so long as the same pipette is used, but different minim pipettes give a different size of drop even of the same liquid. From their form they are much more easily graduated with accuracy than the conical minim measure. The subdivisions of this latter measure are rarely accurate even when the total capacity is correct, whereas the subdivision of the minim pipette can vary only with the calibre of the tube, since they are made with a dividing machine, and such tubes vary very little in calibre within the few inches of the graduation.

Their chief advantage is that they bring a greater degree of accuracy into daily practice than other devices, at a smaller expense, and with least inconvenience in proportion to the degree of accuracy attained. Yet they are very inconvenient at first, and in common with manipulations in general, are not available to the many who object to leave their accustomed usages, even with the inducement to greater accuracy.

To those who are gradually accustoming themselves to the inevitable system of metric values and notation it is only necessary to remember that a fluidounce is about 30 c.c. (29.52), and therefore that a fluidrachm is 30÷8=) 3.75 c.c., and a minim is (3.75÷60=) ·06+ c.c., and that cubic centimetres are roughly but practically the equivalent of grammes.

When the larger "Medicine Measure" is required, no form is better than the common conical old-fashioned wineglass, graduated in terms of table and teaspoonfuls. The teaspoonful here is, with greater or less accuracy of graduation, a fluidrachm, and the tablespoonful half a fluidounce. But of these measures as found in common use only the lower or smaller graduations should be relied upon as tolerably accurate. Patients who have to take any medicine for a long time should always be supplied with one of these measures. For illustration, suppose potassium bromide has to be taken for months or years, as in the treatment of some epilepsies if the treatment be successful, a solution of 100 grains in the fluidounce be supplied a pint at a time, and suppose the dose be 25

grains, the patient or nurse fills the graduated wineglass to the mark for 2 teaspoonfuls, equal to 2 fluidrachms, and then filling up the glass with ice water the dose is taken from the glass.

When the dose is to be increased the solution is increased in strength to 110, 120, or any other number of grains in the fluidounce, the volume to be taken being kept uniform.

A mode of administering medicines which seems to be growing in use, and for which great accuracy is claimed, is that of compressing solid substances into capsules or into tablets by degrees of pressure varying from that of a hand machine to that of an hydraulic press. This method is based upon the fastidiousness of patients, which is indulged by the physician. Patients do not know that the conditions under which medicines do them most good are very limited, and physicians are either thoughtless, or they consider such matters of so little importance as to neglect them. When he does not order the compressed pills or tablets of the proprietary manufacturer, he will yet order the pharmacist to put such quantities of powders into capsules as require much compression to get them in, and will not stop to think that just in proportion to this compression will be the slowness of the solubility and disintegration of the mass. Suppose the capsule to dissolve promptly in the stomach before the mouthful of water with which it is swallowed be absorbed, the external surface of a hard mass is exposed for slow solubility, and the patient, instead of getting the prompt effect of the calculated dose, is getting the continuous administration of doses so small as to be without effect, and in the meantime the mass is moving down the canal to points far below those to which the medicine is addressed.

DISINFECTANTS.

In a note on this subject at page 807 of a former pamphlet, the details were given for making and putting up a solution of Chlorinated Soda of about three times the strength of the minimum limit of the U. S. Pharmacopœia, and it was stated that in putting up this solution ordinary corks were to be used as an experiment with the fear that they might not resist the destructive action of the liquid. That experiment is now ended and it is found that ordinary corks fail to secure the solution. Bottles which have stood erect with occasional agitation have their corks but slightly damaged at the end of three months. But similarly

corked bottles laid upon their sides lose their contents within this time through rapid destruction of the cork. In the agitation of long transportation this destruction would doubtless be still more rapid. The conclusion from these trials is that while corks are available for solution that is to be used within a few weeks, and not to be packed, or be transported far, they are altogether inadmissible for general use.

They were therefore abandoned by the writer after a use of about two months, and were replaced by rubber stopples. Thus far this rubber stopple appears to be affected very little by the solution, so that it will doubtless secure it for all reasonable periods of time, and perhaps as long as the solution itself will remain good. It is better than a glass stopper, because much more easily taken out, and less liable to leak. Although much more expensive than cork it is less expensive than glass, and it is therefore intermediate between cork and glass in modifying the cost of the solution. The figures given for the cost of putting up the solution are rather seriously affected by this apparently small element. The rubber stopple when bought in largest quantity costs 2.4 cents each, or nearly half as much as the contents of the bottle, while the cork costs only about .54 cent., making a difference of 1.86 cents on each bottle, or 22.32 cents a dozen bottles. A profit of 10 p.c. on this brings it to just about 25 cents a dozen bottles, and therefore the prices as previously given had to be advanced from $2.50 to $2.75 per dozen,—so much difference does a small detail like this make.

THE PHARMACOPŒIA OF 1880.

(Review Continued.)

BITTER ORANGE PEEL—Curaçoa Orange Peel. This very nice adjuvant and stomachic occurs in the markets of very variable kind and quality ; but the true Curaçoa kind is generally to be had by careful selection, if the buyer be willing to pay the price.

It occurs "in ribbons" and "in quarters," and the first is much the best, because it has a larger proportion of the outer rind, and is more quickly dried with a shorter exposure, thus losing less of its fine aroma.

The brighter the green color of the outer surface, and the thinner and whiter the inner surface, and the stronger the odor, the better and fresher is the peel.

CHLORIDE OF GOLD AND SODIUM. It is difficult to understand why this salt should have been introduced into the Pharmacopœia. Even with pharmacopœial support, it has rather rapidly fallen into disuse, and is now rarely mentioned in current literature. The florid statements of those who brought it forward some years ago were never fully or generally credited; and now it seems only to be used in occasional cases of syphilitic disease which, having resisted all other treatment, are open to any kind of experimentation. As a substitute for the salts of mercury in syphilis, it has certainly been a great failure, except, possibly, in rare cases where an obstructive prejudice has prevented the use of mercury.

AZEDARACH—Pride of China. Might well have been omitted, because it is of very little importance in the presence of so many better vermifuges.

BALSAMS OF PERU AND TOLU this writer knows very little about, but both are still much used, and, of late years, chiefly in the manufacture of those modern abominations,—"chewing-gums."

BELLADONNÆ FOLIA.

BELLADONNA LEAVES.

The leaves of *Atropa Belladonna* Linné (Nat. Ord., *Solanaceæ*).

Leaves from four to six inches (10 to 15 centimeters) long, broadly ovate, narrowed into a petiole, tapering at the apex, entire on the margin, smooth, thin, the upper surface brownish-green, the lower surface grayish-green, having a slight odor, and a bitterish, disagreeable taste.

Preparations: Extractum Belladonnæ Alcoholicum. Tinctura Belladonnæ.

Although the above description applies accurately to a very few leaves that could be picked out of a bale of belladonna, these would have to be carefully moistened and spread out for examination, all the rest of the bale having to pass unrecognized, being simply a mass of crushed and broken leaves and stems, of a more or less uniform character and color.

When the prevailing color is fairly uniform, and fairly green,—not brown,—when the appearance and odor are free from mustiness, and without signs of previous dampness and fermentation,—when free from admixture with dissimilar leaves or parts of leaves, as digitalis, hyoscyamus, weeds, etc., and when seed capsules with ripe seeds are found the parcel may be accepted as of fair quality, and gathered at the proper time. If the leaves appear to have been

all very large, and are very green, and no capsules to be found,—somewhat like the fancy leaves sold in bottles, at high prices, this is a sign of cultivated plants, harvested when the leaves are most succulent but not most active. Though very attractive and handsome, such leaves are less active than the wild plants taken at their maturity. When a careful buyer is shown various samples of belladonna, not a word of the officinal description is of any avail to him, and he only knows that what is before him is belladonna from having seen it more or less frequently, and the grades of quality are also wholly judged by an experience in judging them which can hardly be conveyed by any description. But belladonna is not unfrequently seen with very considerable admixture of other plants recognized and unrecognized, as though whole patches of ground had been mowed where belladonna was simply the prevailing production These low cheap grades are generally sold for powdering, and then, of course, all discrimination is at an end, because all the landmarks of character and quality are gone.

A very small number of those who buy belladonna, a still smaller number of those who make preparations from it,—and none of those who either prescribe or take it, ever see it in the leaf, in bales, as it comes from abroad. The importing jobber, or the wholesale druggist imports it and has it powdered, and the pharmacist or physician simply buys the powder, and commonly buys it where he can get it cheapest. Hence there is a great need of an assay process by which the value of any given powder can be approximately determined. It is true that very few would apply such a process, however simple, yet it may be quite important to supply one to the few who would use it.

The assay process successfully used by the writer is based upon the same principles as that adopted for cocaine and described on pages 726 and 784; and provided analytical accuracy be not required, the process is simple, easy and quite sufficient for a practical valuation of the leaves or the root of belladonna.

The alkaloid atropine is very soluble in chloroform, but very slightly soluble in alkaline watery solutions; and the portion soluble in these latter solutions may be washed out of them almost completely by chloroform. The salts of atropine are, however, almost completely insoluble in chloroform, and therefore the alkaloid can be washed out of its solution in chloroform by dilute acids; and upon these conditions the following assay process is based:

Take 50 grammes of powdered belladonna leaves, moisten the

powder uniformly with 32 grammes of alcohol s.g. ·820, to which has previously been added ·1 gramme or about 3 small drops of sulphuric acid, s.g. 1.840. Pack the moistened powder in a cylindrical percolator, and exhaust it by percolation with about 300 c.c. of alcohol not acidulated. This is best and most readily done by the use of a Sprengel water pump. Without the pump the exhaustion requires 24 to 48 hours, according to the skill used in packing. But with a pump the exhaustion is effected in about 4 hours, and then the entire assay can be easily finished in a day. Evaporate the percolate in a shallow dish over a vapor bath, at a low temperature, stirring toward the end until the odor of alcohol is no longer perceived. Add to the liquid extract while warm 25 c.c. of water, to which one or two drops of sulphuric acid has been added, stir very thoroughly on the bath so as to incorporate all the extract, cool and transfer the mixture to a separator, page 786, or some equivalent vessel, and rinse the dish in with 1 or 2 c.c. of water, leaving only the clotted chlorophyl and resinous matters adhering to the dish. Pour into the dish about 20 c.c. of chloroform, and by means of the stirrer dissolve all the chlorophyl, etc., adding the solution to that in the separator. Rinse the dish with about 10 c.c. more chloroform applied in parts, pouring the successive rinsings into the separator until the dish is clean. Add now to the contents of the separator about 3 drops more of sulphuric acid and agitate the whole by careful shaking. This shaking should be active and prolonged for about 5 minutes, but should not be so very vigorous as to emulsify the liquids and thus prevent or very much delay their complete separation by rest. If after standing at rest for an hour the separation of the liquids should not have begun, add 3 more drops of acid, again agitate for a minute or two, and again set at rest for an hour. If the emulsion still does not begin to separate add 10 c.c. more of water and chloroform, again agitate, and again set at rest. No specimen of powder has yet been met with which withstood this last procedure, unless the alcohol used for exhausting it had been weaker than s.g. ·820. The stronger the alcohol used the less of this emulsifying matter is carried into the extract. An alcohol of s.g. ·814 used for the exhaustion of the powder never gave any trouble from emulsifying, in any of many specimens of powder tried ; and one of s.g. ·820 gave trouble only in two instances, while if weaker than this the difficulty is not uncommon. When the liquids have separated to a pretty sharp line,—which separation often requires 2 or 3 hours, and sometimes 12

hours,—the chloroform layer is drawn off closely into another separator. The liquids are both so very dark, and so very much alike in color that it is sometimes difficult to see the line of separation, and a strong, reflected light is often required for this. But in drawing off, as the line gets down to the narrow part of the separator it is much more easily seen, and as a rule the drawing off can be done very closely. Fresh portions of chloroform, 10 c.c. at a time, are added to the watery solution,—agitated with it and drawn off into the other separator with the first chloroformic washing until the chloroform comes off nearly colorless. This point is generally reached by three washings, so that at the end there will be an aggregate of about 60 c.c. of chloroform washings in the second separator. Add to this 15 c.c. of water acidulated with a drop of sulphuric acid, agitate the whole well, and allow it to separate. Draw off the chloroform and set it aside for recovery by distillation, and add the watery solution to that in the first separator. Then add to this 20 c.c. of fresh chloroform, and little by little, with careful agitation after each small addition,—6 grammes of crystallized carbonate of sodium. During the saturation of the excess of acid present much carbonic anhydride will be liberated, and with incautious management the process may be lost by frothing over. When the free acid is all saturated the sodium carbonate may be added more rapidly. Under ordinary conditions 6 grammes will be sufficient, but the salt should be in considerable excess, and more must be added until a decided alkaline reaction is obtained. The whole is then thoroughly agitated and then allowed to separate. The chloroform has now practically all the alkaloid in solution in a free state, and is drawn off into a tared beaker. About 10 c.c. of fresh chloroform is added to the watery solution remaining in the separator, and if need be, a little more sodium carbonate, and the whole is agitated, allowed to separate, and the chloroform washing drawn off into the beaker with the first portion. The beaker is then set in a warm place and the chloroform is allowed to evaporate spontaneously. If a dish be used for this evaporation instead of a beaker, the solution, as it becomes dense, will almost invariably creep over the edge, and the whole process be lost.

When the chloroform is all off, the beaker is turned on its side in a warm place and revolved occasionally for an hour, when the varnish-like coating of alkaloid will be sufficiently dried or will have crystallized, as it often does. Finally, it is weighed and the tare subtracted, the remainder being accepted as atropine. But to prove

that it is atropine 5 c.c. of water is added, with a single drop of sulphuric acid, and the whole is rinsed round the beaker by a continuous rotary movement. By this the whole of the alkaloid is slowly converted into sulphate and dissolved, giving a light yellow solution which is nearly clear. In six assays of powder of good quality the weight of crude alkaloid in the beaker varied between ·13 and ·17 gramme, and as 50 grammes of powder was always taken these results were equal to ·26 and ·34 p. c. It is therefore concluded that good powdered belladonna leaves should yield to this process about ·3 p.c. of alkaloid, at least.

In order to obtain still farther proof that the alkaloid is atropine the following process is convenient and is pretty conclusive.

According to Gmelin, Cavendish Society edition, vol. XVI., p. 454, crystallized sulphate of atropine consists of 85.5 p.c atropine, 11.83 p.c. sulphuric acid and 2.67 p.c. water. Then supposing that ·15 gramme of alkaloid was obtained by the assay, this would be equal to (As 85.5 : 100 : : ·15 :) ·17544 gramme of sulphate. It will be shown farther on that about 1 part of the sulphate in 228 parts of solution constitutes the ordinarily used solution of 2 grains to the fluidounce, and that 1 drop of this 2 grain solution in 400 drops of water makes a dilute solution, 1 drop of which dropped into the eye should produce some dilatation of the pupil within an hour.

As the 2 grain solution consists of 1 part in 228 parts, then the ·17544 gramme of salt should make (·17544×228=) 40 grammes of the 2 grain solution, and it is only necessary to bring the contents of the beaker up to that weight with water to have 40 grammes or $1\frac{1}{3}$ fluidounces of the 2 grain solution, provided the process of assay yielded ·15 gramme or ·3 p.c. of atropine, and whether this was all atropine or not is to be known by the physiological test.

One drop of this 2 grain solution to be tried is to be added to 399 drops of water. But as the counting of drops accurately is troublesome, and so much dilute solution is not required, 1 drop of the 2 grain solution is added to 40 of water, and 1 drop of this is added to 10 drops of water, making a proportion of 1 : 400.

The head of the person on whom the trial is made should be thrown back so that the face presents upward. Then holding the lids of one eye open by the thumb and finger of one hand, a single drop is delivered from the dropper held in the other hand, directly upon the cornea of the eye. The lids are held from winking for perhaps 15 or 20 seconds in order to prevent them from closing and

forcing too much of the drop down the ~~Eustachian tube~~ lachrymal duct. The person then goes about his business, but is watched every 10 minutes until the pupils of the two eyes are seen to differ in size. If the whole product of the assay has been atropine, in about 35 minutes to an hour the one pupil will be seen to be larger than the other, and will generally, in about 1¼ hours, be nearly double the size of the other. From this maximum it will gradually return to the normal in about 6 hours. If the trial fails on one person it should be tried upon a second or a third, and as there is neither pain nor inconvenience from the trial, it may be repeated freely. If the trial of this dilution fails altogether, stronger solutions may be made and tried until that which gives the amount of dilatation is reached.

Belladonna leaves are used by the Pharmacopœia to make the Alcoholic Extract and the Tincture, while the root is used for making the Abstract, the Plaster and the Fluid Extract, and yet there is no distinction made in the names to indicate which is used for which preparation, although the root is about one-third stronger than the leaves.

Confusion would be avoided, and a great improvement made by omitting the leaves altogether, and having the root only officinal, and all the preparations made from that.

BELLADONNÆ RADIX.

BELLADONNA ROOT.

The root of *Atropa Belladonna* Linné (Nat. Ord., *Solanaceæ*).

In cylindrical, somewhat tapering, longitudinally wrinkled pieces, from half an inch to an inch (12 to 25 millimeters) or more in thickness; externally brownish-gray, internally whitish; nearly inodorous, having a sweetish, afterward bitterish and strongly acrid taste, and breaking with a nearly smooth and mealy fracture.

Roots which are tough and woody, breaking with a splintery fracture, should be rejected.

Preparations: Abstractum Belladonnæ. Emplastrum Belladonnæ. Extractum Belladonnæ Fluidum.

This is much the more important part of the belladonna plant, first, because it is much the strongest or most active part; second, because it is most uniform in strength; next, because it is less liable to be contaminated with parts of other plants; next, because it is more easily dried without injury, and less liable to injuries by dampness, etc., in transportation and keeping, and, finally, because it keeps better and longer without deterioration. In short, it has the

advantage over the leaves in all the most important qualities proper to medicinal substances.

Two parts of the belladonna plant are certainly unnecessary, and where one is so much stronger and more easily manageable for preparations, two become not only unnecessary but objectionable. In such cases duplicates are not simply surplusage, but are confusing and even dangerous. This latter disadvantage appears prominently when it is noticed that the officinal Alcoholic Extract is made from the leaves, while the Fluid Extract is made from the root, both unchanged from the revision of 1870, except that the word "Root" is dropped from the title of the Fluid Extract of 1870.

The officinal description seems to be a little at fault in two or three respects. The roots though originally cylindrical are generally split to facilitate drying. At least all the larger ones are split, in the best parcels of the drug. They are somewhat wrinkled longitudinally, but perhaps more wrinkled transversely, and most of the markings are transverse. The fracture is squarely transverse, but not smooth, and the exposed structure is spongy, the spaces radiating from the centre.

The description very properly omits the peeled root, which is not uncommonly preferred in the market and commands a higher price; but it has been repeatedly shown that the bark and subcortical layers usually removed with it, are very rich in yield of alkaloid, and it may be reasonably suspected that the fashion of peeled root is kept up by the sale of the peelings to the makers of atropine. At least, if the root be judged as it is met with in the market the peelings would yield more alkaloid than the entire root, and considerably more than the peeled root.

As in the case of the leaves, the root is commonly bought and sold in powder, and very few pharmacists or physicians ever see it except in cabinets or museums, where selected specimens tend much more to mislead than to instruct, because, as a rule, such specimens are never seen in any considerable quantity in commerce.

The powder is of a dirty whitish color, and, everything else being equal, the whiter and handsomer it is, the poorer. Old, discolored and damaged root is not very unfrequently "brought up" in color in the grinding process, and would not be salable if this could not be done, since it would not be handsome enough.

An assay process is of as much importance in the case of this powder as for that of the leaves, and the process there given is

equally applicable here with the great advantage of being much more easily applied. While the leaves contain much chlorophyl and other embarrassing matters, the root is comparatively free from such and is easily exhausted.

In the application of the process as described the only modification needed is that in moistening the powder for a successful percolation much less liquid must be used. From 15 to 20 grammes of strong alcohol acidulated with 3 drops of acid is sufficient to moisten the powder, and the packing should be rather light, otherwise a pump is almost indispensable here. The extract after the evaporation, is much less in the case of the root, and far less loaded with troublesome extractive matters. No difficulty was encountered with emulsifying in exhausting the extract from the root, the liquids separating promptly, and one or two washings here are more effective than three in the case of the leaves.

The range of difference in different specimens of powder was just about the same as in the leaves, the extremes being between ·42 and ·50 p.c., so that a good powder of the root should yield, by this process, at least ·46 p.c. of crude atropine.

The quantity of alkaloid actually obtained, say ·25 grammes, when converted into sulphate in the way previously described would yield (As 85.5: 100:: ·25) ·2924 grammes of sulphate. Then as the standard solution of 2 grains of the sulphate in the fluidounce of 456 grains is 1 part in 228 of solution, this ·2924 grammes of sulphate should yield (·2924×228=) 66.67 grammes of the 2 grain solution, while the same quantity of the powder of the leaves yielded 40 grammes.

The average difference in strength between the samples of powdered leaves and powdered root assayed was (·46—·30=) ·16 p.c., or over 20 grammes of the 2 grain solution from the 50 grammes of powder. Hence the root is stronger than the leaves by about 50 p.c. Or, 1 part of the powdered root is equal in atropine strength to 1.5 parts of powdered leaves.

The statements of authorities upon the relative strength of the leaves and root of belladonna are very discordant, but no such difference as that here given has been found. Indeed, the high authority of Dragendorff is quoted in the U. S. Dispensatory, 1883, p. 283, from Jahresb. 1874, p. 96, as having found ·66 p.c. of atropine in the dried leaves, and ·4 p.c. from the roots.

Mr. A. W. Gerrard, F. C. S., in a Report to the British Pharmaceutical Conference, 1884 (see Year Book of Pharmacy and Trans-

actions of the British Pharmaceutical Conference, 1884, p. 447), found the leaves of the English plants to yield about ·449 p.c., and the root ·350 p.c.

The writer is, however, confident that the results here given are fairly accurate, and that the relation between leaves and root is correct for good specimens of both, as imported from Germany in large quantities, every specimen assayed being from qualities far above those of the common market.

In order to test the above results the equivalent of a 2 grain solution was made as above described, and a solution of the same strength was made from the make of foreign sulphate of atropine which is almost exclusively used in this part of this country, and the two solutions were tried upon the eyes of 18 different persons, as follows:

The solutions of sulphate of atropine were carefully made as described, and each represented accurately 2 grains in the fluidounce.

The one was a stock solution made from the imported sulphate, in large quantity, and therefore very accurate.

The other was made from the crude, yellow, varnish-like alkaloid from the assay process, and this simply air-dried, as the spontaneous evaporation of the chloroform left it. This was made into solution by the described calculation, giving a transparent solution of a pale yellow color.

The object was to compare these solutions in strength, as shown by their effect upon the pupil.

The dropping tube used was the ordinary "French Pipette," as commonly sold and as figured in the first part of this pamphlet. This pipette, when held in a uniformly inclined position, delivered, by repeated trials, just about 100 drops for 60.18 grains or 3.9 grammes. That is, the 100 drops measured slightly more than a fluidrachm or 60 minims, and a little less than 4 c.c., and the delivery was the same for the two solutions and for distilled water. This pipette was used for making all the dilutions, and for delivering the solutions upon the cornea.

In every trial a single drop only was used, and this was delivered upon the cornea, the lids being prevented from closing for a few seconds in order that the spasmodic action should not drive the solution into the lachrymal canal too quickly. The pupils were always compared for size before the application, and were then watched every few minutes to note the time when the dilatation

began. The time of maximum effect was also noted, as well as the duration of the dilatation, but these periods were only roughly observed, as they were not important elements in the trial.

The trials were made upon 18 different persons, and therefore as many different degrees of susceptibility were obtained. Many of the individuals were repeatedly used, but never until the previous dilatation had entirely disappeared, and then the eye last used was avoided in the new trial.

The first trial was with the assay solution of standard strength (of 2 grains in the fluidounce). One drop of this gave a dilatation within 10 minutes, which in 15 minutes had very nearly taken the iris out of sight, leaving a mere ring of it visible, and giving an uneasy sensation suggestive of an ache. This dilatation continued at its maximum for at least 72 hours—was still very great at the end of a week, and had not entirely disappeared at the end of 9 days.

The second trial was with this same solution diluted to half strength. This gave a maximum dilatation in about 17 minutes, with discomfort and disturbed vision, and the pupil was one-half larger than the other at the end of a week.

All the others were parallel trials of the two solutions, always two, and sometimes three individuals being subjected to each solution at the same time.

The first pair were made with a dilution of 1 drop of the standard solution in 10 drops of water. With this proportion the stock solution gave a dilatation commencing in about 28 minutes. The assay solution in 15 to 18 minutes. The dilatation was greater from the latter solution, and from both it continued during 2 days.

The second pair was with dilutions of 1 drop of the standard solutions to 20 of water. From the stock solution the dilatation commenced in 30 minutes, and from the assay solution in 20 minutes, —the latter giving the greater dilatation, and for the longer time.

The third pair was with 1 drop in 40 of water. This trial was anomalous from some unknown cause, as the stock solution in two individuals required 40 minutes to give a commencing dilatation, while the assay solution in two individuals gave the same effect in 15 minutes.

The fourth pair was with 1 drop in 80 of water. Commencing dilatation in 50 and 32 minutes, two persons. The assay solution in 18 and 34 minutes, both showing a very great difference in susceptibility.

The fifth pair was with 1 in 100. Commencing dilatation in 50

and 35 minutes from the stock solution,—55 and 50 minutes from the assay solution.

The sixth pair was with 1 in 200. Commencing dilatation in 45 and 45 minutes from the stock solution,—45 and 35 from the assay solution. Maximum in 1½ hours. Duration about 10 hours.

The seventh pair was with 1 in 400. No dilatation from the stock solution in either of two individuals of more than average susceptibility. From the assay solution dilatation commenced in 45 and 50 minutes, and reached a maximum of fully double the size of the other pupil in about 1½ hours, and passed off in about 6 hours.

The eighth pair was a repetition of the last, 1 in 400, but with fresh dilutions; 3 individuals gave from the stock solution in about an hour a dilatation which was scarcely perceptible in any at the end of 1½ hours, and in 2½ hours was not perceptible. From the assay solution the effect was much more decided, and for a longer time.

The series ended with this trial, as it was concluded that the practical limit of the test had been reached.

By these trials it is shown, first, that the substance obtained by the assay process is atropine, and that the entire residue, crude and colored as it is, taken weight for weight, is much more active than the highly artistic and thoroughly decolorized salt of the foreign maker. It was shown when considering sulphate of atropine that by careful precipitation the salt did not yield the proportion of alkaloid required by good authorities, and now it is found less active in fully the proportion of the deficiency. Yet it is about the best salt obtainable in this market, and therefore the test of a midriatic effect from a single drop of dilution of one drop of 2 grain solution in 400 drops of water is available and useful.

The remarkably small quantity of sulphate of atropine which will produce a decided effect on the iris of the human eye, is brought out very prominently by these trials.

The 2 grain solution of the crude alkaloid from the assay, converted into sulphate, contains 1 part or grain of the salt in 228 parts or grains of the solution, and 1 drop of this solution weighs ·6 grain, and therefore contains (·6÷228=) ·002631 grain, or ·000171 gramme. This quantity was sufficient to cause a maximum dilatation of the pupil in fifteen minutes, which did not entirely disappear in nine days.

The four-hundredth part of this quantity or (·002631÷400=)

·0000066 grain, or ·000000427 gramme, gave a very decided dilatation in fifty minutes, which continued during six hours. It becomes a little easier to comprehend the minuteness of the quantity indicated by these decimals by noticing that ·66 grain would give this effect on 100,000 persons.

The next step was to endeavor to compare the fluid extracts of the leaves and the root with the materials from which they are made. And as by far the largest quantities of belladonna are used in the form of fluid extracts, it is of importance to be able to ascertain the quality of the leaves or root represented in the fluid extracts, especially in view of the fact that so much powder of inferior quality is sold to make these preparations from, and that the true character of the powder is entirely hidden in the preparations.

To this end an assay process applicable to the extracts, fluid extracts and tincture is desirable, and a physiological test also.

The process of assay given for the powders is equally applicable to these preparations, when modified to suit their conditions. The fluid extract, whether of leaves or root, should represent the powders in the proportion of minim for grain, or volume for weight, and therefore 50 c.c. should represent the 50 grammes of powder from which it is made. But frequently, if not commonly, these fluid extracts are made with Diluted Alcohol, or a menstruum composed of two parts of alcohol to one part water. The officinal Fluid Extract, however, is made from the root and with strong alcohol, and, therefore, if made by repercolation, has merely to be acidulated and evaporated exactly as directed for the percolate from the powder. But when weaker alcohol is used, and when the weak percolates are evaporated, the liquids become so loaded with emulsifying organic matter that the process cannot be applied directly to the fluid extracts. They must first be freed from this extractive matter. This, however, is easily done by the use of strong alcohol, as follows:

Take 50 c.c. of the fluid extract, representing 50 grammes of powder, whether of the leaves or root, put it in a bottle of about 400 c.c. capacity, add 3 drops of sulphuric acid diluted with 1 c.c. of water, and 150 c.c. of strong,—s.g. ·820,—alcohol. Shake the mixture vigorously and allow it to stand over night. A sufficient proportion of the extractive matter will thus be precipitated, and will have formed a dense layer at the bottom of the bottle. Pour off the nearly clear solution into a shallow evaporating dish,—rinse the bottle and precipitate, without disturbing the precipitate, with about 5 c.c. of alcohol,—add the rinsings to the main portion in the dish,

and then proceed exactly as directed in the assay process described, adding a drop or two of acid, diluted,—to the extract, when it is to be dissolved by the water and chloroform, as directed. The liquids do not always separate as promptly as in assays of the powders, but in the few applications of the process yet made to fluid extracts, no insurmountable difficulties have been met with. The acidulated watery solutions are always turbid, but being well acidulated the preliminary chloroform washing removes from them no alkaloid salt, but does remove all matters soluble in chloroform, the chloroform coming off free from turbidity and but slightly colored. Then, after the addition of the carbonate of sodium to the turbid solution to free the alkaloid, the latter is brought away by the chloroform quite free from the turbidity of the saline solution above it.

Assays by this process were made of fluid extracts taken from stock kept in 2 gallon bottles. These fluid extracts were made from the identical stock powders, the assays of which are among those given when considering the powders. The fluid extracts were made by repercolation without heat, and are believed to be accurate representatives of the powder in the proportion of minim for grain, and therefore 50 c.c. represent very nearly 50 grammes of powder. The menstruum used for exhausting both the leaves and the root in making the fluid extracts was 2 parts alcohol s.g. ·820, and 1 part water. The present Pharmacopœia, however, uses alcohol undiluted for its Fluid Extract of the root, and this is probably a better menstruum for excluding more of the inert extractive matter, although it renders the preparation more expensive, and is otherwise objectionable.

The stock powder of the root gave by assay ·50 p.c. of crude alkaloid.

The stock fluid extract, made from this powder, gave ·52 p.c.

The stock powder of the leaves gave ·34 p.c., and the fluid extract from this powder gave ·342 p.c. of crude alkaloid, thus showing them to be practically in accord.

Fluid extracts will therefore yield by this assay process the same results as the powders from which they are made, and therefore the process will usefully control the material used in making fluid extracts.

The process has not been applied to either solid extracts or tinctures, but there can be little doubt of its applicability. The weighed portion of extract to be assayed should be exhausted by strong al-

cohol, and this acidulated and evaporated as with the fluid extract, —the remainder of the process being the same for all.

It was next desirable to apply the physiological test directly to the fluid extracts, and the identical fluid extracts, the assays of which are given above, were used for the tests.

The 100 drops of water, delivered from the bent "French Pipette" previously used, measured 4 c.c., and the first step was to get one hundredth part of this replaced with the same volume of the fluid extract.

It was found that from the same dropper, held in the same position, 264 drops of the fluid extract of the root, and 250 drops of the fluid extract of the leaves, were required to make 4 c.c., and therefore that in the one case 2.64 drops, and in the other 2.5 drops were required to make the volume of one drop of either water, or the standard 2 grain solution with which the fluid extracts were now to be compared. Therefore 5 drops of the fluid extract of the root were added to 92.5 drops of water; and 5 drops of the fluid extract of the leaves to 98 drops of water, to give a proportion of 1 drop in 50, had the drop been of the value of that of the standard 2 grain solution. These solutions were therefore accepted as being one part of each fluid extract in 50 parts of water.

One drop of each of these solutions was then farther diluted with 8 drops of water, giving a proportion of 1 of fluid extract in 400, as had been used in the previous trials.

One drop of each was put into one eye in four persons.

The four upon which the preparation of the root was used gave a wide dilatation in 50 minutes to 1 hour. In two of these the dilatation was scarcely perceptible in 9 hours, while in the other two it was not entirely gone in 24 hours.

The four with the preparation of the leaves were all much less dilated. In two the dilatation was slight but distinct in about 1¼ hours, and in the other two no dilatation could be detected in a strong light, but a very distinct slight dilatation when the person stood with his back to the light.

One drop of the 1 : 50 solution was then more largely diluted with 10 drops of water, making a proportion of 1 in 500, and after an interval of 24 hours these solutions were tried in the other eyes of the same persons.

The fluid extract of the root gave distinct but not so wide dilatation in two, and slight dilatation on the other two, all distinctly visible in a pretty strong light, but the last two much more distinct with the back to the light.

The fluid extract of the leaf was applied to 6 persons, including the 4 of the last trial, without distinct dilatation in any, though a very slight effect in obscure light was suspected in 2 persons.

The final dilatation was 1 drop of the 1 : 50 solutions in 12 drops of water, giving a proportion of 1 of fluid extract in 600 of water.

From the preparation of the root there was no discoverable effect in 3 out of 5 persons, but on the other 2 the effect was decided, though very slight, in an obscure light.

From the preparation of the leaves there was no discoverable effect in any of 7 persons tried.

Two drops of each of these final dilutions in one eye of each of two persons, gave from the root a full maximum dilatation in an hour, lasting 24 hours ; and from the leaves about half the amount of dilatation, of shorter duration, but the time not ascertained, as it went off during the night.

By the assays the quantity of alkaloid obtained from 50 c.c. of the fluid extract of the root gives 66.64 grammes of the standard 2 grain solution, and therefore the fluid extract is (66.64–50=) 16.64 grammes, or about 33.28 p.c. stronger than the 2 grain standard solution, but the physiological test shows that there is a much greater difference than this in activity, because the fluid extract diluted to 1 : 600 is about as active as the 2 grain solution diluted to 1 : 400, which is 50 p.c. against 33.28 p.c.

The alkaloid obtained by the assay from the fluid extract of the leaves gives 45.6 grammes of 2 grain standard solution, and is therefore (50–45.6=) 4.4 grammes, or about 10 p.c. weaker than the 2 grain solution, but the physiological test shows it to be stronger or more active, since a dilution of 1 : 500 seemed to be but little less active than 1 : 400 of the 2 grain solution.

That the difference in physiological effect between the leaves and root is not equal to the difference in the respective yields of atropine is very confusing, and cannot be explained.

The conclusions thus reached are supposed to indicate that good German belladonna leaves should yield by assay not less than about ·3 p.c. of atropine, but that leaves may be had by those willing to pay a proportionate price, that will yield ·34 p.c. But that belladonna leaves are not the best part of the plant for medicinal uses, nor for making any of the medicinal preparations, and therefore should go out of use.

Next, that good, unpeeled, German belladonna root should yield

not less than ·46 p.c. of atropine, but may easily be had of such a quality as to yield ·50 p.c., and that the root is by far the best part of the plant for medicinal uses, and as a material for making all the medicinal preparations.

Next, that well made fluid extracts by repercolation fairly represent the leaves or root from which they are made, and that the quality of the leaves or root used to make them can be ascertained by an assay of the fluid extracts.

Next, that in order to produce a given midriatic effect, from a uniform quantity of atropine present in the different conditions, the fluid extracts are the most active; the crude atropine from the assay process, without bleaching or refining, stands next, and that the refined and bleached salt is weakest of all,—indicating that the active principle is most active in its natural condition, and is progressively weakened by the processes of extraction and purification, even though unchanged in quantity.

These results have a very important bearing upon the relative doses of the various preparations.

Authorities in general treat the powdered leaves and root as being alike, and give the dose of either to begin with as being 1 to 2 grains; but as it has been shown that when of fair quality they differ in strength as 30 is to 46, or more than one-third. Therefore if the dose of powdered root to begin with, be 1 grain, the equivalent dose of powdered leaves is 1.5 grains; and this would make the equivalent dose of sulphate of atropine ·0053 grain or ·00034 gramme, good authorities giving $\frac{1}{60}$th grain (see U. S. Dispensatory, 1883, p. 226). But as $\frac{1}{60}$th grain is equal to ·0166 grain this dose is equivalent to more than double that given by the same authority for the powdered leaves and root.

The dose given for the Fluid Extract is 1 to 2 minims, which agrees with that of the powder, but the dose given for the Alcoholic Extract being $\frac{1}{4}$ grain to begin with, is much smaller than that given for the powder of the leaves and the Fluid Extract. Leaves of fair quality yield about one-fourth their weight of alcoholic extract, and therefore one-fourth of a grain bears the proper relation to the leaves. But as the leaves are one-third weaker than the root, the dose of extract equivalent to 1 grain of the powdered root should be one-third larger at least. As much of the activity is lost in the evaporation for the extract, it is probable that half a grain would be more nearly the equivalent of 1 grain of powdered root.

To sum up the dosage, if 1 grain equal to ·065 gramme of the

powdered root be adopted as the standard dose to begin with, then the equivalent dose of—

Powdered leaves will be about	1.5 grains or ·097 gramme.
The officinal Alcoholic Extract (of the leaves)	·5 grain or ·032 gramme.
The officinal Tincture (of the leaves)	10 minims or ·625 c.c.

The sulphate of atropine, equivalent to 1 grain of good powdered root, would be as follows: If the root yields ·46 p.c. of atropine, this is equal to ·53 p.c. of sulphate, and therefore 1 grain would be equal to (·53÷100=) ·0053 grain or about $\frac{1}{190}$th grain of sulphate, or to ·00034 gramme, and that would be the equivalent of the standard dose of 1 grain of powdered root. But the authority above quoted gives the dose to begin with as being from twice to three times as great. It has been shown that the extracted sulphate is weaker than the atropine in its natural state, but the difference cannot possibly be so great as to account for this discrepancy.

It has been stated that the preparations of belladonna were better than those of atropine salts for therapeutic uses, and if the foregoing investigations are trustworthy, as they are believed to be, this statement is fully confirmed. But for hypodermic use and for the uses of ophthalmologists the solutions of the salts of atropine are not only best, but are indispensable.

In regard to the use of sulphate of atropine by the ophthalmologists it would appear that it is used in too large quantities. They require a very prompt action in their examinations of the eye in order to save time, but in this interest they apply so much of the agent as to render their patients uncomfortable, and prolong the dilatation unreasonably. Then if they desire to counteract the dilatation by the use of eserine, so strong a solution of this is required as often to be painful. It seems altogether probable from the above experiments that if solutions of sulphate of atropine of one-fourth the strength of the standard 2 grain solution were used but little time would be lost, and all discomfort and excessive dilatation might be avoided.

Indeed the writer has been informed by a very prominent and skillful ophthalmologist that he now uses a solution of sulphate of atropine of half a grain to the fluidounce much more commonly than a 2 grain solution with more satisfactory results, and finds the accommodation much less interfered with.

AN EPHEMERIS

OF

MATERIA MEDICA, PHARMACY, THERAPEUTICS AND COLLATERAL INFORMATION.

VOL. II. NOVEMBER, 1885. No. 12.

CORRECTION.

By a careless and inexcusable slip of the pen in writing, a ridiculous blunder is made at the top of page 853 where Eustachian tube is written instead of lachrymal duct. This seems to be a curious relic of exactly the same mistake which was made by Prof. Pancoast when the writer was a student of medicine. Prof. Pancoast demonstrated the lachrymal duct to his whole class as the Eustachian tube, until the laughter of the students showed him there was something wrong, and then his discovery "brought down the house"—he as much amused as any one.

FALSE CUBEBS.

There have been, within the current year, three papers upon the subject of false or spurious cubebs, all in *The Pharmaceutical Journal and Transactions*, of London. The first of the three is in the number for February 14th, page 653, by Mr. Wm. Kirkby. The second paper is in the number for May 9th, by Mr. E. M. Holmes, F.L.S., page 909; and the third in the number for June 6th, page 1005, by Mr. E. D. Gravill.

The general conclusions reached in these three papers seem to be that there are two berries now occasionally met with as cubebs which are false or spurious,—the one being a different species of the same family as the true cubeb, and the other a laurel berry. That the first very closely resembles the true cubeb, and the second less closely, and that one or both are liable to be mixed with true cubebs, either in separate bags of the same lot, or more intimately

mixed in the same bags with true cubebs, or in the powder of cubebs as sold.

The first paper concludes that the differences between the true and the false drug are that the false berries are larger, of a lighter color, with a stouter and flattened stalk, and a very different odor. And that there is a microscopic difference in the number of the rows of cells in the endocarp, and a smaller difference in the number of woody bundles, though it is possible that this last character may not be constant. This evidently applies only to the berries of the substituted species of the Piper genus, and not to the laurel berry.

The second paper treats mainly of an adulterated powder which had been used with bad effect, and gives some color tests by which the adulterated powder was distinguishable from that which was not adulterated; but the indications from Mr. Holmes' testing do not definitely determine whether the powder was adulterated with the one or the other of his spurious cubebs. He seems to think that the Piper crassipes was used to adulterate, while from his evidence and that of Dr. Shillitoe, this reader judges that the laurel berry Daphnidium Cubeba was the adulterant.

The third paper chiefly applies the color testing of Mr. Holmes to tinctures of cubebs, and properly disclaims any aim at very great accuracy.

After reading the first of these papers this writer began to watch this market pretty closely for these substitutes, and was soon after shown in the New York Custom House a bag of the false cubebs. On a very cursory examination of this bag, without a sample for comparison, it was simply regarded as a bag of very poor cubebs, but no worse than many constantly seen in the market for years past. It was very "stemmy," and feeble in odor, but the odor was markedly that of cubebs, and of cubebs only,—as was also the taste. From this examination the writer concluded that the examiner was mistaken in supposing this to be false cubebs, although no careful buyer would have taken it for good cubebs, even after having been sifted, or freed from stems and dirt.

No farther indications of false cubebs were met with until July last, when a sample was presented for judgment which represented a few bags, which had been passed by the Custom House authorities, and sold by a house of excellent standing in the market. After having been resold, through hands familiar with the drug, they were objected to, and samples were sent to three good pharmacognocists. All three pronounced them to be false cubebs, and

this writer was then called on for an opinion, and a large sample was submitted.

It was at once seen that they were not laurel berries, and were free from admixture with these, and that if they were false, they were so nearly like the true that they must be of the Piper family, and therefore from the Piper crassipes. When closely compared with three samples of different grades of undoubted cubebs from the market, the berries ran generally slightly larger than two of the samples, but of about the same size, or if anything a little smaller than the sample of highest quality. They were lighter in color than the latter and one other of the samples, but slightly darker than the third or poorest sample. The taste in all, tried at different times, and taking each sample first in turn, was alike in all as far as quality was concerned, but was different in strength, being strongest in the larger darker berries of each sample. The odor to casual observation was also the same in all, but when more carefully tried, and the whole large sample taken at once, there was a faint but distinct odor of nutmeg or mace superadded to the stronger cubeb odor. Upon distillation the yield of oil was very small, though not smaller than from poor qualities of undoubted cubebs ; but in the oil the mace-like odor was much stronger than in the berry and was like that of oil of cubebs, which might have been adulterated with a small proportion of oil of mace. In external appearance, taking the whole of the samples for a general effect, they were substantially alike. The stalk was flattened in many berries of all the samples, but perhaps was flattened in larger proportion in the doubtful sample. On cutting many berries of each sample in two, and examining them with an ordinary glass of about four diameters, they were practically alike,—or rather there were as great differences in the berries of each sample as in the berries of different samples.

To sum up then, the only difference of note between the doubtful sample and the poorest of the three samples with which it was compared was, in addition to the cubeb odor, the mace-like odor of the first, no trace of which could be detected in the second. Unfortunately the sample of poor cubebs was not distilled, but there is every probability that had it been, it would have yielded a poor, thin oil, in small quantity, but without the contaminating mace-like odor.

From all this it was concluded that this lot was not false cubebs, but was the product of the true Piper cubeba growing under conditions of locality, climate, soil, etc., such as are known to modify

other drugs. For example, there are quite as marked differences between different samples of black pepper, of allspice or pimento and of cloves as between these samples of cubebs. While in Cardamom, as an example of seeds, Cinchona, of barks and Rhubarb, of roots, it will be admitted the differences are much greater ; yet no one would call the inferior grades of these drugs false or spurious, unless they differed more than the cubebs appear to do.

In regard to the color tests with sulphuric acid they are hardly trustworthy in discriminating between species of the same family. The proportion and quality of the oil present in the same species, too, very much modifies the color reactions with the acid, so that it is highly probable, though untried, that good and bad specimens of undoubted cubebs would give as much difference in color as between good cubebs and the doubtful specimen.

To fairly account for the presence in the markets of considerable quantities of very poor cubebs from new and perhaps doubtful sources, as well as for the presence of adulterants of all kinds, it may be useful to give a slight review of the New York market for this drug during the past few years.

During 1879 the jobbers' prices for cubebs up to November varied but little from 15c. per pound, only reaching 18c. during four of the ten months. Somewhere about this time the cubeb cigarette became prominent, and a single enterprising mercantile house commenced the speculative "cornering" of the drug for the supposed purpose of cheapening the large quantities used in the cigarettes by high prices to the consumption for other purposes. It was said in the market that this house controlled not only all the cubebs of this and the London markets, but had also controlled the orginal sources of production and supply in Java. However this might be, in November, 1879, the price of cubebs in this market became just about double the October price, the speculative rise being from 15c to 30c. in one month. This rise, however, was not maintained, and the December quotations were at 27c.; January, 1880, 25c.; February and March 20c., and by June they were back to 15c. The speculation was, however, not given up, for by November, 1880, the price was again 30c., and during 1881 there was a steady advance until November, when the price reached 75c. It then fell off again, and by March, 1882, was at 30c., but only for a short time, for another speculative movement then carried the price, by October, to 90c. Then in November, 80c., December, 75c., January, 1883, 55c., February, 40c., when another rise was managed

which by September reached 85c., and by January, 1884, $1.00 per pound. Through 1884 the monthly quotations were 90, 80, 75, 85, 85, 50, 80, 75, 55 and 55c., and in January, 1885, 50c. But in February and March 90c. was asked, then 85, and up to August 75c.

Now under this condition of market it is not surprising that anything which will sell as cubebs is brought forward, and that while cigarettes are supplied with the original good drug, the medicinal uses must be supplied with a very poor article at four to five times the real value, or if of very good quality at five or six times the former cost. The effect of this upon the markets wherein price is the first consideration and quality the second is, of course, easily understood.

If the figures and dates given be closely inspected they indicate that cubebs have been managed as skilfully as other drugs in the near past, and very much after the model of stocks and bonds in the financial markets. That is, they have been regularly depressed to buy up, and then as regularly advanced to sell, and in order to carry on this mercantile enterprise successfully the ordinary sources of supply must have been under some control in this interest. This, of course, would stimulate other and new sources of supply, which, for a time at least, would not be under the same control. This leads this writer to the inference, — which is probably true, though unsupported except by the single fact that cubebs have appeared in the markets slightly differing from those of previous years,—that the islands around the original and main source of supply are under the stimulus of high prices and profits, sending into the markets the products of different varieties and sub-varieties of the true Piper Cubeba. Whether such products will be found to yield either identical or similar therapeutic effects to the older drug remains to be seen.

So long, however, as the good cubebs are not used for cigarettes, any one who wants them badly enough to pay the speculative prices for them can always get them, for as yet there has been no scarcity, but only very high prices for those of good quality.

BLISTERING BY CANTHARIDES.

Frequent complaints have reached the writer, during many years past, of the quality of preparations of cantharides which are used for blistering, and it never satisfies the complainants to tell them

that great care is taken both in selecting the cantharides and in making the preparations, for they are sent back and condemned notwithstanding. The Cerate of the Extract of Cantharides is the preparation least complained of, while the Cerate is next in order, and the Cantharidal Collodion is the preparation most frequently sent back. The writer has long known that the fault was not in the preparations, but only in the mode of applying them, but has also long known the uselessness of stating this to the pharmacist or physician, so that of late years they are in most cases simply taken back and the money returned without attempting to discuss or discredit the statements concerning them. This, however, cannot be done in all cases, and in such the following course is pursued and reported at considerable cost of time and trouble, and this course is published here that those who see it may satisfy themselves of the quality of their blistering material.

A small space on the inner side of the forearm is selected, and one-half of it is carefully cleansed first with soap and water, and then with dilute acetic acid or vinegar. Then two spaces of about half an inch in diameter each is covered with the vesicant, one upon the cleansed surface, and the other upon the adjoining uncleansed surface. Commonly by the end of 5 or 6 hours the spot on the cleansed surface will be blistered, and often both will be blistered if the weather be cool and the skin dry. But in summer weather, or if the skin be moist with perspiration, the uncleansed surface will rarely be blistered, and often will not even be reddened, while the cleansed surface will almost always be blistered.

The explanation of this is found in the circumstance that the active principle of cantharides is not soluble in water, and therefore a very thin film of water will prevent the blistering preparation coming in contact with the cuticle. Both the healthy and unhealthy excretions of the skin are liable to so cover it as to prevent the necessary close contact, and even soap and water, unless very thoroughly applied, do not always remove these excretions. But the excretions which are not removed by soap and water are easily soluble in dilute acetic acid or vinegar, while the active principle of cantharides is also freely soluble in acetic acid, and hence the utility of this old-fashioned mode of cleansing the surface for a blister.

These complaints are most frequent in summer, and come from the use of the cantharidal collodion. The explanation of this, is that in warm weather the skin transpires moisture so rapidly, that even

when well cleansed and well dried a film of moisture may be thrown off under the blistering preparation before it can act upon the cuticle and thus separate it as effectually as though it had been applied to wet skin. In occasional trials of cantharidal collodion to a perspiring surface, especially when active exercise has been taken after the application, thus promoting transpiration, the pelicle has been found detached and therefore of course quite without effect. It is believed that upon a clear dry skin that is not perspiring the collodion never fails to blister, and it has the advantage over the cerates of so strengthening the cuticle that it may, if desired, be kept in place indefinitely.

ASSAYS OF COCA.

In watching the arrivals of coca, samples from some of the largest and best lots have been assayed by the process given in these pages, with the result that four lots varying in size from 4 bales up to 20, gave ·5, ·55, ·59 and ·6 p.c. of cocaine.

An experimental shipment of Bolivian coca imported from Arica by the writer, and alleged to be of the very best quality, arrived in July, and did not give results as good as the commercial lots.

The shipment consisted of six tambores. Three were put up in one large bale covered well with tarpaulin over the palm bark, and then bagging over the tarpaulin. The other three were soldered up in a box of sheet zinc. The shipment was much delayed, having been allowed by some mismanagement to lie over two steamers at Panama in the hottest weather. Upon opening the bale the leaves were found to be very warm and moist, the temperature at the centre of the bale being probably above 110° F., the heat being evidently due to commencing fermentation. The leaves, however, were still in good condition, though not as good as when they started, having been put up too moist. On assay they yielded ·52 p.c. In this bale were found two bars of quite new iron weighing between six and seven pounds each, which were evidently fraudulent, and were paid for at the price of very high grade coca, namely, at over sixty cents per pound.

The leaves that were soldered up in zinc were in a rather worse condition than the bale. They, too, had been insufficiently dried when packed, and were quite warm. The layers next the zinc had suffered most, and an assay of the very outermost portions of these gave only ·4 p.c. of cocaine.

NOTES OF TRAVEL.

The Cunard S.S. Etruria, being one of the most recent results of the progress in marine engineering, is probably one of the most advanced, and would certainly seem to leave little to be expected in the future. When it is remembered that some of the conditions required in the problem of building steamships, are that they must bear with safety a variation from the horizontal normal, in every possible direction, of some 25 degrees of arc,—one moment in one direction and the next in the opposite one;—that under all such disturbances they must be forced through the water at a high rate of speed, carrying in safety hundreds of tons of freight and hundreds of passengers,—the degree of success attained seems to be very wonderful. To secure all practicable safety at their constantly increasing rates of speed, they must not only resist the emergencies of the sea and the weather, but also the constantly increasing risks of collision as the ocean becomes more and more filled with craft of all sizes and rates of speed,—and what this means will be understood when the momentum of a mass weighing many thousand tons, going at the rate of eighteen to twenty miles an hour, is considered. Hence the counter-braced steel hulls, and water-tight compartments, and the very complicated meshes of beams, stays, bulkheads, etc.,—with greatest strength where greatest strains and greatest exposure are known to be. The gain of every mile of speed per hour increases most of the difficulties of the problem, and a run which day after day does not vary ten miles from 430 in the twenty-four hours is an achievement of human skill worthy of great respect and admiration.

Then comes the secondary considerations of economy of time and labor, and the comfort and health of large numbers of passengers. The enormous amount of freight carried must be got in and out with the smallest expenditure of time and labor, and over-fastidious and sea-sick people must not only be carried in comfort, but in luxury too, and must be protected often against themselves and their whims by sanitary conditions and arrangements of the highest order. This ship Etruria is certainly a notable example of all this, but especially so in her sanitary arrangements. Her Board of Health is perhaps the very best that any crowded community can possibly have, —namely, a superabundant supply of good, fresh, clean water, well distributed through free outlets. With the general habits of human beings in this age it is very doubtful if water can be wasted, if well distributed and delivered through proper mechanical appli-

ances in small outlets at proper localities. A great profusion of baths, closets, urinals and wash basins scattered throughout all the decks where passengers are placed, is perhaps the most important of all her sanitary provisions, while it adds much to the comfort and convenience of sick and half-sick people, and saves the pollution of their state-rooms. The mechanical appliances of this profuse distribution are so complete, so substantial and so skillful in their construction as to set at defiance the large numbers of ignorant, careless and thoughtless people whose forte seems to be to put everything out of order that can be deranged. That cleanliness which is next to Godliness is most easily attained and maintained, and is even in a manner enforced by well and skillfully distributed supplies of water, as is very well illustrated in this ship. Her ventilation is also excellent, even under the severe conditions imposed by ship-construction, for it seems to make very little difference in the quality of the air in her rooms whether the air-ports and doors be open or closed. When so many people are asking frivolous questions one does not like to subject himself to the stinted courtesy of officers, but as far as could be observed a part, at least, of the fresh air taken in through the very large number of standing metallic air shafts, whose funnel-shaped mouths are carefully kept directed to the wind, is forced through pipes into all parts of the ship,—inhabited and uninhabited,—and may be drawn out by steam power. A forced ventilation is, however, very evident throughout the ship, and is certainly very efficient. The cooking is all done upon the spar-deck, in rooms open on both sides, so that all the smoke and smells are blown off at once, and no products of the enormous galleys go below the main or saloon deck. The fresh food is kept in rooms in the forecastle, where a temperature of about 32° F. is maintained by compressed air supplied by an engine, which runs day and night, thus giving to the table a supply of wholesome food which was always of good quality, well cooked, and moderately well served. With all these advantages people are carried about 3,300 miles, and are fed and lodged during nearly a week for $125.00,—or for about 4 cents a mile. Another class of passengers, however, are carried, with all the most important of the advantages for about $25.00,—or less than 1 cent a mile. With such prices and the low freight rates it is not wonderful that the companies pay no dividends on their stock, and that the latter sells much below par.

The great drawback to all these advantages and comforts is sea-

sickness, a malady which has been discussed and treated for ages without success either in prevention or cure. On shipboard, however, almost everybody has a cure, which, in common with cures for other disorders, is seen in an inverse proportion to the experience with it. One who enjoys the sea with only the recollection of sea-sickness in the long past time, gets much amusement from the theories which are advanced and defended among a set of passengers. One tells another that if he will keep his stomach empty he cannot be sea-sick, because then the stomach will have nothing upon which to be sick. Another directs that the stomach be kept well filled, because then it will have something to do all the time and have no time to be sick. Another directs the patient to sit or lie with closed eyes, because then the motion will not be visible, and as the motion is the cause of the illness, there can be no illness. These are the philosophers. Next come the advocates of special remedies to be swallowed, each individual having his special agent from bromide of potassium and citrate of caffeine down to the quack nostrums of the day, but the poor patients who take them, whether hopefully or through coaxing or badgering, pay their respects to the sea, or to the steward's basin, all the same, so that there seems really to be no use in trying to interfere unless some complication arises, or the voyage and the sickness be long enough continued to threaten permanent damage from inanition. What will temporarily settle one person's stomach will often make another worse, and inclination to or experience with various simple articles of food are, after all, the most to be relied on. A toddy of brandy at night, or a glass or two of iced champagne occasionally through the day, seem to be useful to many persons by alleviating the nausea and supporting the powers of endurance until the sea habit is established.

Among the sanitary arrangements of these ships it must not be forgotten that a physician is always supplied, and on this ship he seems to be a progressive one with an eye to business, as he is said to have told a brother physician, who was a passenger, that he had a very good remedy for sea-sickness. When asked what it was he declined to tell, as he expected to make some money by it.

But the crowning institution of this ship is the "steamer chair." In good weather and with over 280 passengers the chairs were necessarily in close proximity, so that with every disposition to read, or to enjoy the restful view of the sea in quiet, and with no desire at all to overhear conversations not meant to be overheard, both reading and resting were often out of the question. At one time

pet dogs, of which there were two or three on board, had to be caressed and discussed and absent ones described. Their virtues and their ailments never seemed to get tiresome, and one of them took Appolinaris water after meals. At another time the wonderful cures of rheumatism by magnetic brushes were set off very vividly against the want of success of physicians. Again an animated discussion had to decide whether Robinson Crusoe had a cat or no, or only had a parrot, and so on through a wearisome series of inane subjects most of the way to Queenstown, except when seasickness overcame garrulity, or uncomfortable weather kept people below. It was, however, very remarkable that with such a class of passengers as might be expected in these ships, whose language and manners all showed education, there should be so great a lack of subjects for intelligent conversation. Even the trashy novels lying on and around the chairs in some profusion did not once get into the conversations as overheard. There were very many quiet, silent passengers, but they could not read, nor could they enjoy the sea even when not sea-sick, and it was a great pity that the shallow and garrulous ones should be so numerous as to give their character to the whole scene.

A magnificent ship, delightful weather, and a glorious, smooth ocean, all a good deal spoiled by the number of grumblers and the silly small talkers.

On walking through the streets of three of the principal cities of Ireland some remarkable contrasts with American cities are noticeable. Cork, with a population of say 80,000, has clean well-kept streets, and very dirty people of the lower classes. In a walk of an hour through streets of all kinds only five pharmacists could be counted, and not over ten physicians' and surgeons' signs. In Dublin and Belfast the proportion was scarcely greater. No occupations involving the necessities of life were found in so small numbers, and the establishments looked thrifty, but unostentatious. In any similar examination in the United States the number would pretty certainly be twice as great. Not one was seen with any sign of a drinking fountain, or with tobacco or cigars, but patent medicine signs were quite common, or rather were universal. Now as the physicians in Ireland are known by their schools and by their writings to be fairly educated therapeutists, and as there must be, of course, enough of them to supply the necessities for their skill, it would seem to follow that in the United States there are far too many, and that this overcrowding of the two professions must be

very hurtful, not only to the best interests of the professions, but to the community at large. The reasons why these professions are overcrowded in the one country and not in the other are not apparent. The numbers are equally unrestrained by law, so far as the writer knows, in both countries, and there is no great difference in either the death rate or the rate of sickness. There are far more schools of both medicine and pharmacy in the United States, but their courses and modes of teaching profess to be as complete, and the educability of their students may be supposed to be equal, but are the examinations for degrees equal? Probably not, and then the next question is whether if more rigorous in the United States than they are, this would prevent the overcrowding. Another question suggested by this overcrowding is, why does not the law of survival of the fittest take better control, or a more prompt control of the matter? While the number of schools and the number of graduates of each continually increase far beyond the increase in population and rate of sickness, and while the number who survive by immoral and quackish practices also increase in proportion, the number of those fittest to be successful appears to remain stationary and to be very small. Another very strong contrast observed in the streets is the large proportion of soldiers seen throughout Ireland, leading to the inference that the Government needs the presence of a large military force for some reason not very difficult to find.

Another very clean and very healthy looking city is Glasgow, and here again very much is doubtless due to a very copious supply of excellent water. Some years since the waters of Loch Katrine were brought to the city by a large aqueduct, and are now very freely distributed upon the plan of very numerous small outlets, so that the supply is very profuse, and, as a result, the washing away of refuse matters is so prompt and rapid that they hardly have time to become hurtful, and are poured into the river Clyde in such a state of dilution as not to become very noxious until they are washed away by the tide. To casual observation the cleanliness of the streets seems to be due to the advantages of a plan known only in the United States, where the inhabitants of small localities keep their streets clean at their own expense. A man, woman or boy with a brush, a shovel and a barrow, appears to have charge of a certain space to be kept clean, and is constantly employed upon it, and the area swept by a single individual seems so large that the plan cannot be expensive. But however this may be, the result, as far

as clean streets are concerned, is very satisfactory. In Glasgow the same sparseness of signs of physicians and pharmacists is noticeable. The pharmacies seem to be, with a few exceptions, small, clean and well appointed; no drinking fountains nor cigars, and but little perfumery or fancy goods, and rarely much display of signs of specialties or patent medicines. All looked thrifty, and in many more than one customer appeared to be in waiting. Often one clerk only, or what seemed to be the proprietor in the front of the store, while in the rear there would be two or more assistants apparently putting up prescriptions for those in waiting.

In Edinburgh very much the same conditions were noticed. Here, too, a very copious supply of water comes from the Pentland Hills, and is distributed in what might be mistaken for wasteful profusion. In the renowned University there is not only a department of practical pharmacy exceeding in extent and in practical appliances for individual study any institution the writer has ever seen, but there is also a department of public health that is thoroughly organized and equipped. Here were displayed all the various appliances for the distribution and utilization of water, and for the care and safety of the sewage therefrom. As an example of what has been said of the profusion in the use of water, it was observed that the water closet which stood at the head of those exhibited, and the one observed to be in use at the best and most modern hotels, was one requiring perhaps not less than two gallons at each flush, and one which held nearly a gallon at the time of receiving excretions. Such usage must enforce a dilution of sewage so great as to deprive this important element of much of its danger. A most important safeguard thrown around the interests involved in the medical art by this University, is that its required curriculum is four years. But many of its best and most successful graduates are men who take five and six years for their preparation. The professor of Materia Medica has, beside his lecture room and museum, over a dozen rooms in constant use for practical work and study, and several of the branches, anatomy and physiology, for example, have many more. In short, it is not easy to see how the opportunities for the thorough equipment of a medical man could be improved, whilst the large hospital,—Royal Infirmary,—which adjoins the new University, gives to advanced classes of students abundant opportunity of seeing the instruction practically applied, both in medicine and pharmacy. The influence upon materia medica and pharmacy of the very large and widely known manufacturers of medicinal chem-

cals and preparations must have been very good in Edinburgh. Both Messrs, Duncan, Flockhart & Co., and T. & H. Smith have dispensing stores in the city, which appear to be models in their way, and the occasional signs on other stores of names "late with" these firms show that they have been successful as practical schools for pharmacists. More pharmacies were noticed in Edinburgh than in the other cities which have been mentioned, and in one locality five were counted within a quarter of a mile,—two proprietors each having two of these stores. Still in other parts of the city which were seen the number was judged to be considerably below that in similar cities of the United States. No drinking fountains nor tobacco were seen in any store, and the number of those which paraded nostrums was small. The front portions of most of the best stores were small, and all seemed to offer small varieties of toilet articles. The number of physicians' signs in the streets visited seemed very small indeed,—smaller than in any other city noticed, and in strong contrast with streets of a similar character in the United States, yet few, if any city stands higher than Edinburgh in the skill with which the medical art has long been applied.

The smaller towns seen in Ireland and Scotland do not differ from the larger ones in the apparent contrast with those of the United States in the number of physicians and pharmacists. Almost every one above the size of a village has a public dispensary, where advice and medicines are given free of cost, and these places generally look neat and clean and have the air of being much used. It is probably due to the number and popularity of these dispensaries throughout the kingdom that recently Parliament, in extending the franchise, refused a proposition to withhold the right to vote from all persons who received public medical charities. In several English towns noted the contrast appeared to be as great. In such a town as Stockton-on-Tees, for example, with a population of about 50,000,—a most active and busy place,—there are not more than 5 or 6 pharmacists, or about one to each 10,000 of population ; and the physicians in active practice were said to be hardly more numerous. Both pharmacists and physicians, therefore, had good occupation, and were doing well at a very moderate scale of prices and charges, since moderate profits on a large business are much better than large profits on a small business, because they are better for the community as well as for the business. And as the cost of these items aid in making living dearer, so they add to the cost of labor and make all its products dearer also. In

Stockton the number of stores which sold exclusively fresh fruit,—not counting the street stands,—was greater than the number of pharmacies, while the number of flower stores was only one short.

Even in London, with its admirable school, and under the free trade and competitive influences of a great metropolis, the contrast is marked, while the general thrifty condition of the establishments is also marked. Here the combination with the drinking saloon is occasionally seen, but none were noticed that were licensed to sell spirits.

In Germany, however, the contrast is greatest. Here the effect of a legal limitation in the number of pharmacies is conspicuously seen, and the character and appearance of the establishments are very much changed; and this change is maintained in Copenhagen and Christiania. In Hamburg, with a population of about half a million, the number of pharmacies is said to be not over twenty-five, and in Copenhagen,—population about 250,000,—the number does not exceed ten. These pharmacies, as a rule, have no large show-windows, and in their small, inconspicuous windows may often be seen a few growing plants,—sometimes medicinal plants,—but never in such number as to seriously exclude light. Occasionally the prominent one of large cities occupies all of the two or three stories of a large building, the upper parts being used as laboratories and store-rooms. The lower story, or dispensing room, is commonly large, always fitted up neatly and often elegantly, but without much effort at display, and without advertisements of any kind. Everything looks clean, neat and very orderly, having a quiet, professional air. Behind the counters are two or three intelligent, neat looking clerks of quiet deportment, very polite and attentive, and handling their implements with apparent dexterity and precision; and these implements, so far as could be seen, were exceedingly plain and simple, but having an air of good workmanship and accuracy. No loud talking, and often no talking at all for considerable periods,—each clerk giving undivided attention to his occupation, and, as a rule, all occupied, so that a person entering may get no attention for a minute or more. Then, however, the supervisor, or the clerk whose present duty seems most nearly finished, steps in front of the new-comer, generally receiving a folded paper, and asking the person to be seated. In a few short opportunities, at different places, it was rare to see a person come with a verbal message, and still more rare to see any one bring a vial to be filled, and it was understood that

prescriptions are never repeated without a special order from the prescriber. There appears to be very little self-prescribing done through these pharmacies. That is, very few persons buy medicines over the counter for their own use, as is so largely done in Great Britain and in the United States. It happened that not a single instance was seen anywhere of a person coming in and asking for so much money's worth of anything, such as laudanum, spirit of nitre, castor oil, paregoric, etc., and not a single demand for any proprietary medicine or nostrum. No nostrums were in sight anywhere, and no ready-made pills or potions were seen; but it was not uncommon to see, in a case or closet, bottles of carbolic acid and other disinfectants, with various popular labels on them, and bottles of tooth-wash, cologne water, etc., with the label of the pharmacy.

The number of bottles on the dispensing shelves was always very great, and as very little seems to be done for parade or show, it is difficult to understand the use of so many. The locked closet for powerful agents was generally to be seen, and, so far as could be observed, the vials containing them were very small, indicating a frequent re-supplying of the quantities to secure freshness of unstable articles. The receptacles for vials, corks, labels, etc., seemed to be large and convenient, and were universally well supplied with clean, fresh looking contents. The clerks seemed to be most busy about midday, probably after physicians had made their morning calls, but even when busiest everything seemed to be done with quiet deliberation and order, which was evidently the result of daily repetition in orderly, smooth-working establishments.

As the writer never made his profession, nor the objects of his inspection known, he had no opportunity of seeing prescription files, laboratories, etc., and these notes are merely offered as being what any one would see on entering the establishments for a few minutes at a time, either on trifling errands or simply to look about; but in these very superficial observations enough was seen to convince him that the large number of physicians and pharmacists in the United States, and the resulting competition and struggle for existence, is neither for the best interests of the professions nor the communities at large, and this suggests the inquiry as to why so many persons crowd into these overfull professions where the struggle for a living is so great. This struggle for existence is, of course, the normal check, which in time must control the number thus entering, but for many years past the struggle seems to have gone on without operating as a natural check, since year by year the over-

crowding continues to increase. The problem then seems to be, can anything be done to replace the inactivity of the natural check?

In a free country, effective legislation seems out of the question, since schools, like all other kinds of business, may multiply without hindrance, and their curriculum may be as complete or as incomplete, and their examinations for degrees may be just as superficial or as profound as they please to make them.

Must the professions in question wait for the slower operation of the ultimate natural check. As these professions run down in their quality they will, of course, run down in their real utility to the communities upon which they must depend for support, and therefore for existence, since they must cease to exist when unsupported. Hence, it will become a question not of professions but of individuals; and while the professions as such decline, the individuals who are really useful through the definite results they yield to the public will be successful in proportion to their knowledge and their practical results.

Then slowly, as they demonstrate their utility and become numerous enough, they may again crystallize into definite form as professions of a new and higher order. Some such action seems to be going on already, and to be illustrated in those schools which are honestly and not superficially striving for a better curriculum, and a more strict rejection of those who fail to be educable to a high order of knowledge and skill.

NOTICE.

The readers of the EPHEMERIS will observe by the above notes that the principal writer of the pamphlet is abroad on a tour of recreation and inspection for a longer or shorter time, as circumstances must determine. His errand is also intimately connected with the business of his past life, inasmuch as a better knowledge of how and where to obtain the best qualities of the commercial articles of the materia medica is a prominent object of his journey. To know the markets of the world, and their availability for supplying the commodities required, is undoubtedly among the most important of the interests of manufacturers,—and to know them one must see them,—or at least to see how they are made up, and to become familiar with the relations of supply and demand, and, if possible, to establish good channels of supply. For many years

past the need of more definite and intimate knowledge of this kind has been felt by the writer, and now the opportunity of trying to obtain it has been made.

Under these circumstances the publication of this series of pamphlets is now, with regret, abandoned, and this number will be the last to be distributed. Whether the publication and distribution will ever be resumed will depend upon circumstances, which cannot be forejudged at the writer's time of life.

END OF VOL. II.

INDEX.

A

B

C

F

G

H

I

K

L

M

N

R

S

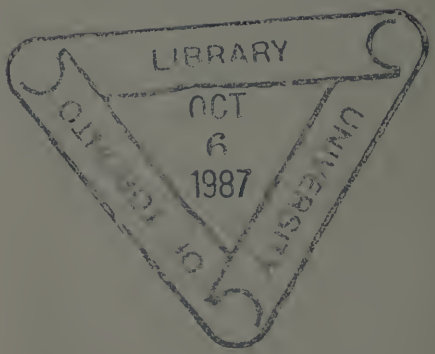
T

U

V

W

Z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AUTHOR: Squibb, E

TLE An epheme
pharmacy,
collatera

v. 1: 188
SERIES v. 2: 188

(2 vols.)

PLACE, PUBLISHER, DATE

Brooklyn:

DATE REC'D

July/87

BDG. INSTRUCTIONS