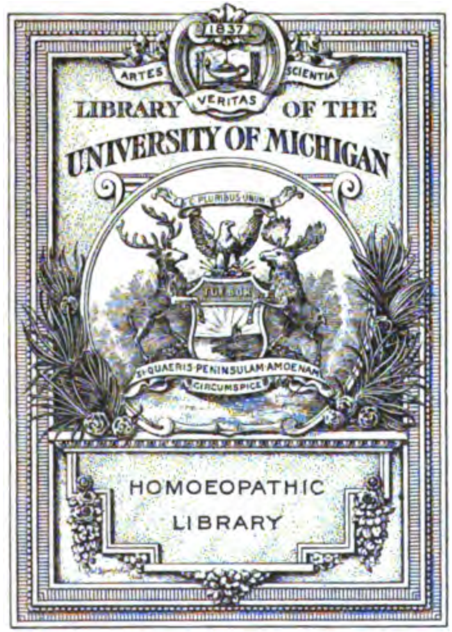
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CLINICAL GUIDE

BY

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CONTENTS

PREFACE

This is practically the author's office memorandum book of tests and diagnostic items.

The first chapter gives the result of the author's wide experience with various tuberculins in diagnosis and treatment. Concise directions are given for a simple method of preparing the dose and administering the more useful tuberculins. The author believes that this is the first appearance in the English language of Professor Denys' technique and rules for the use of bouillon filtre. A unique feature of the book is the Glossary of Tuberculins, pages 22 to 25, in which each of the many tuberculins is described and its usefulness indicated.

In the chapters on urine, gastric contents, blood, sputum, smears and typhoid diagnosis, only simple, accurate and practical tests are given. The author has used them hundreds of times. They are in daily use in his office.

The final chapters include the author's experience with diagnostic puncture, the Krönig and the Goldscheider percussion, auscultatory percussion, the oral auscultation of Takata, the use of thiosinamine, the use of the rectal bougie, test diet for diabetes, specimen records and such data as a student or a physician attending a post-graduate course in clinical medicine would copy into his note-book. To save hunting through various books and journals, the author copied most of them long ago into his own note-book. Some of them are not yet available elsewhere in English.

TUBERCULIN.

Tuberculinum of the homœopathic materia medica is a potentized dilution of consumptive sputum. It was introduced by Swan, in 1878, long before Koch's preparations.

Bacillinum of the homœopathic materia medica is a trituration to the sixth potency and subsequent dilution of the caseous matter of a tubercular lung. J. C. Burnett began using it in 1885 and published his observations in 1890, just after Koch's announcement.

However, in general medical literature to-day, the homœopathic preparations are unknown. The word *tuberculin* is understood to mean the series of preparations of tubercle bacilli or their toxins inaugurated by Koch in 1890, with what is now called *original tuberculin* or *old tuberculin, Koch.*

These tuberculins are aqueous-glycerin extracts of tubercle bacilli or emulsions of the bacilli themselves. The active principles are the soluble poisons excreted by the bacilli, together with, in some instances, the poisons contained in the bacillary bodies, the endotoxins.

The early tuberculins, including the homœopathic preparations, were made from bacilli of human tuberculosis. Calmette tuberculin was always of bovine origin. To-day, most preparations of tuberculin can be obtained as desired, derived either from human or from bovine bacilli.

Tuberculin is a remedy worth knowing but it is no specific for tuberculosis. It fails in the cases that need it most and succeeds best in those cases that need it least, the early and slowly progressing cases.

A true specific remedy for a disease should unmistakably cure a large number of cases of that disease with a uniformity that comes to be reliable. This, no one has been able to do with tuberculin. A meningeal or miliary tuberculosis or a moderately advanced tuberculosis of the lung, pleura or peritoneum is still an incurable disease. Long before tuberculin was introduced we expected certain cases of tuberculosis to get well. It is the author's opinion that most of the cases that get well with the use of tuberculin are those which we formerly expected to get well without it.

Nevertheless, as stated, tuberculin is a remedy worth knowing. In diagnosis, it is of daily helpfulness. In early tuberculosis of the lungs, it hastens the cure and perhaps makes it more certain. Under its use, cases of suspected early tuberculosis and cases of pneumonia with delayed resolution may return to health with surprising rapidity. Its best curative action is shown in tuberculosis of the bones and joints and glands. All these are notably mild forms, tending to recovery under many forms of treatment.

Varieties.

The innumerable tuberculins in the market confuse the novice. The beginner in tuberculin therapy will do well to familiarize himself first with the two most useful tuberculins, old tuberculin and bacillus emulsion. Familiarity with the dose and action of these two varieties is the key to an understanding of the rest of them, both old and new.

For description of the different varieties of tuberculin, see *Glossary of Tuberculins*, page 22.

TUBERCULIN IN DIAGNOSIS.

Use only *old tuberculin, Koch.*

For diagnosis, tuberculin can be dropped into the *eye*, rubbed into the *skin* or injected *hypodermically.*

The *hypodermic method* is the method of choice. It is the most reliable but also the most dangerous if used indiscriminately.

The *conjunctival reaction*, ophthalmo-reaction or eye test should be abandoned or restricted to veterinary practice. It endangers the integrity of the eye and is no more conclusive than the skin test. Two drops of a freshly prepared 1% watery dilution of old tuberculin are dropped into the outer canthus of one eye. A reaction of redness and swelling of the conjunctiva with lachrymation appears in 12 hours, reaching its maximum on the second day. Serious ophthalmia has occurred.

The *cuti-reaction* or skin test is perfectly safe but not conclusive. See page 8.

Diagnosis by Hypodermic Injection.

Caution. Do not use tuberculin in diagnostic doses in advanced or rapidly progressing tuberculosis nor where there is rapid loss of weight or hæmorrhage or rise of temperature to 100 F. or over. Under these conditions, such a dose will aggravate the disease and hasten the fatal termination.

The place for tuberculin in diagnosis is in early, suspected or slowly progressing tuberculosis with no hæmorrhage and little or no fever.

The Author's Technique.

Take the patient's temperature every two hours for three days to determine the individual variation. About bedtime, on the third day, inject 3 milligrams of old tuberculin.

Beginning ten hours after the injection of tuberculin, take the temperature every two hours up to twenty-four hours from the time of injection. During this time, the patient should remain quietly indoors so that nothing may interfere with the expected reaction.

Preparation: Boil or sterilize a one ounce bottle and cork and a hypodermic syringe with needle.

Fill the bottle two-thirds with water that has been boiled *and cooled.*

Add one drop of Koch's old tuberculin from the lip of the tuberculin bottle. Shake.

Of this solution, 5 drops contain one milligram. 15 drops contains the diagnostic dose of 3 milligrams.

Interpretation: A *healthy* human subject injected with a large dose, 25 milligrams, of old tuberculin will experience a series of phenomena called the reaction. He will have headache, nausea, oppression of the chest, cough and rise of temperature. The reaction appears in from 10 to 18 hours after the injection, seldom as early as five hours or as late as 30 hours interval.

In a healthy subject, a dose of 10 milligrams or less has no effect. Tuberculosis is recognized by the reaction occuring with a much smaller dose than in health, with 5 milligrams or even one-one-hundredth of a milligram.

The Reaction.

The reaction is threefold, constitutional, local and focal.

The constitutional reaction is indicated by chill, rise of temperature, headache, nausea and vomiting; cough; sometimes high fever and delirium. Usually there is only rise of temperature of 2 degrees F. and headache. The constitutional disturbance lasts from a few hours to 48 hours.

The local reaction consists of swelling and redness around the point of injection. Sometimes there is a large tumor of purplish color resembling a phlegmon. These tumors suggest those of angeio-neurotic œdema. They never suppurate and they disappear without requiring treatment.

The focal reaction is an inflammatory congestion of the tubercular focus. In a lupus ulcer, the increased redness, swelling and inflammatory exudation are visible. If the tubercular focus is in the lung, the inflammatory congestion is shown by increased percussion dulness, crepitant rales, increased cough and hæmoptysis. Sharp focal reactions aggravate the disease and are undesirable. They rarely appear with a dose of 3 milligrams unless given to an inappropriate case.

Of these three reactions, the constitutional is the most significant. The local reaction is the least significant (see Cuti-reaction, page 8.) In the lungs, the focal reaction should be too slight to be detected.

Caution: In a tubercular subject, the diagnostic dose is also the first therapeutic dose. Do not give any more tuberculin for at least 4 weeks. See *Tuberculin Therapy, The Author's Method*, page 10.

If, in a case where the suspicion of tuberculosis is strong, there is no reaction to 3 milligrams or a reaction so slight as to be uncertain, repeat the dose of 3 milligrams on the second day after the first dose. A sharper reaction on the repetition of the same dose is conclusive evidence of tuberculosis.

Tuberculin Diagnosis in Children.

With children under three years of age, the cuti-reaction is reliable and sufficient. After that age, the hypodermic method should be used. Most observers place the dose for children at one-half the adult dose. Koch recommends a series of 0.1, 0.2, 5.0 and 10.0 milligrams, as described on the next page. The author's observation with children agrees with the wide experience of Holt who recommends one-half milligram as the diagnostic dose for them. If there is no reaction, repeat the same dose on the second day after the first one.

Bovine Tuberculin in Diagnosis.

In diagnosis, old tuberculin of human origin is used universally except perhaps in France where the Calmette (bovine) tuberculin is popular. The reaction to bovine tuberculin does not differ essentially from that to tuberculin of human origin except that it is apt to be delayed, occurring 30 hours after the injection instead of 12 or 18 hours. If tuberculin of bovine origin is used, keep the patient quiet and take temperature for two days after the injection.

Tuberculin Diagnosis. Hypodermic Method. Koch's Technique.

Some tubercular patients are excessively sensitive to tuberculin; others require large doses. To avoid too violent reactions and yet not overlook the insensitive cases, Koch and most European workers use a series of five doses;

First day	0.2 milligram
Third day	1.0 milligram
Fifth day	5.0 milligram
Seventh day	10.0 milligram
Ninth day	10.0 milligram

With children and weak or delicate adults, the initial dose is 0.1 milligram; the second dose 0.2 milligram; the other doses as usual.

When reaction occurs, the series is discontinued. A rise of temperature of even ½ degree F. is regarded as a reaction. If uncertain of the reaction, the dose is not increased but the same dose repeated. A rise of temperature of half a degree F. higher than before is regarded as a positive reaction.

In this country, it is difficult to persuade patients to take this series of injections. In the author's opinion, it is unnecessary and may be unwise. Frequent repetition of the dose may do the patient more harm than a moderately sharp reaction from a single dose *if no more tuberculin is given.* As the reaction subsides, improvement will ensue. Nor can the author endorse carrying the tuberculin test to the rigid conclusion of two doses of 10 milligrams. The diagnosis of tuberculosis is only a relative question. Most of the adult human race have a tubercular focus somewhere about the body. It is not necessary to inject large doses of tuberculin to learn this. What we require from the tuberculin test is information whether a given case of illness is due to an active tuberculosis. This can be determined by small doses of 3 or at most 5 milligrams.

TUBERCULIN DIAGNOSIS. THE SKIN REACTIONS.

The skin reactions include the methods of von Pirquet, Moro, Arloing Lautier and Ligniere. The idea was originated by von Pirquet in 1907. For description of the less important methods, see *Glossary of Tuberculins*, page 22.

The Cuti-Reaction of von Pirquet.

Required: Old tuberculin, Koch.
Brad-awl, scalpel or needle to denude the skin.

Technique: On the skin of the forearm, chest or abdomen, denude three small spots, $\frac{1}{8}$ inch in diameter, separated from one another by at least three inches. The skin should not be scratched to the point of drawing blood but the superficial epithelia should be scraped off. The best instrument is a small brad-awl which is pressed lightly against the skin and twirled.

Rub a drop of tuberculin into the two outer spots leaving the middle spot untreated as a control. The spots should be far enough apart so that the clothing does not rub the tuberculin over the control. No bandage or other dressing is necessary. The patient returns on the second day for observation.

In patients of low vitality, the reaction is sharper on the skin of the chest or abdomen than on the forearm, perhaps because the skin is more delicate or warmer and better supplied with blood.

Interpretation: The result may be positive, negative or doubtful. *A positive reaction* is the development of a papule on the spot rubbed with tuberculin. To be positive:

the papule must be red;
it must be elevated above the surrounding skin;
it must be one-fourth inch or more in diameter and extend beyond the area scarified.

The papule begins to form after a few hours, reaches its greatest development in 48 hours; then disappears gradually, leaving no scar though a slight pigmentation may remain for many months. A curious phenomenon after a hypodermic injection of tuberculin is the blazing out afresh of an old skin reaction long faded.

The positive reaction shows that the patient at some time has had some form of tuberculosis, it may be present and active or long past and healed. In children under three years, it is strong evidence of active tuberculosis. In older children or adults, a positive skin reaction has no significance.

A negative reaction is one that shows no difference between the spot treated and the control. It is observed in those who have never had tuberculosis and also in advanced tuberculosis with little reactive power.

A *doubtful* or a *negative* reaction should be repeated after a few days. It may then be positive. If the second reaction is distinctly stronger than the first, it is regarded as positive. Such a delayed reaction or one that does not begin until more than 24 hours after the application usually occurs in children that are probably tubercular but in whom tuberculosis is not clinically demonstrable.

With patients far advanced in tuberculosis, there may be no reaction or there may be the "cachectic reaction," slight elevation but no redness.

With scrofulous children there appear around the large papule smaller red follicular papules resembling lichen scrofulosorum. This is the scrofulous reaction.

The Skin Test in Prognosis.

The skin test is negative in those who have never had tuberculosis and also in far advanced cases with no reactive power. It has, therefore, some prognostic value.

In a case of known tuberculosis, a negative skin reaction is of bad prognosis, indicating vital failure.

In a case of known tuberculosis, a positive skin reaction is of better prognosis, indicating good reactive power.

The Moro Test. The Percutaneous Test.

Ointment of 50% old tuberculin in lanolin is rubbed into a small area of skin for 1 minute. The reaction appears in the form of small red papules. The interpretation is the same as in the von Pirquet.

TUBERCULIN THERAPY.

THE AUTHOR'S METHOD.

The physician trained in homœopathic thinking will understand the author when he says that he uses tuberculin like psorinum or sulphur or any other anti-psoric to rouse vitality and recuperative power. Give one sufficient dose. Watch for signs of improvement and give no more until improvement stops. See *A Homœopath's Criticism*, page 20. Begin treatment with old tuberculin, changing to bacillus emulsion as described below.

In the administration of tuberculin, the secret of success lies in judging properly the size of the dose and the frequency of repetition. It is on these points that the various methods of using tuberculin differ from each other.

The dose will depend on whether the case is mild, moderately severe or a severe, advanced case.

In a severe, advanced case of pulmonary tuberculosis give no tuberculin whatever unless in the two-hundredth potency at intervals of two weeks or longer.

Do not inject tuberculin in patients with pulmonary tuberculosis with hæmorrhage or fever reaching 101 F. or one who is losing weight and strength rapidly. The usual therapeutic dose will aggravate the disease.

A mild, early case of tuberculosis is one in which the temperature does not reach 100 F. The physical strength is fair. Loss of weight has been only gradual and not extreme. There is no hæmorrhage. There may or may not be tubercle bacilli in the sputum. Percussion dulness and crepitant rales are slight or absent. It may be a patient that is only suspected of tuberculosis on account of frequent catching cold or persistent cough with moderate loss of weight and daily temperature variation of 2 degrees F. In all these cases, the initial dose of old tuberculin is usually the diagnostic dose of 3 milligrams, except in lung tuberculosis with crepitant rales and percussion dulness, where the diagnostic dose of 3 milligrams is unnecessary for diagnosis and should not be given. Here, the initial dose should be one milligram.

Frequency of repetition is determined by cessation of improvement. The most reliable sign of improvement is increase of weight, which often sets in within a few days after the dose of tuberculin and continues for several weeks. Weigh the patient every week. As long as weight increases, do not repeat the dose.

With the increase of weight there is often a feeling of increased strength or well-being. As long as this condition is evident, do not repeat.

When it is evident that improvement has ceased, repeat the dose of one milligram of old tuberculin or give .005 milligram of bacillus emulsion.

If a patient in good condition neither improves nor is aggravated by one milligram, after two weeks, give a second dose of 5 milligrams. If there is no improvement nor aggravation from this dose, give .005 milligram bacillus emulsion. If still there is neither improvement or aggravation, it is probably not a case of tuberculosis and treatment may be discontinued.

If, in an undoubted case of tuberculosis in good general condition, there is no improvement whatever and no aggravation, a dose of 3 milligrams or possibly 5 milligrams may be given two weeks after the initial dose and then two weeks later .005 milligram bacillus emulsion. If there is still no improvement nor aggravation, it is not a case for tuberculin therapy. Tuberculin should be then discontinued or used only in the minutest dose of one-one-hundredth of a milligram of old tuberculin, one ten-millionth of a milligram of bouillon filtré or .0025 milligram bacillus emulsion.

Changing the Tuberculin.

During the course of treatment, it is well to change from time to time from old tuberculin to .005 milligram bacillus emulsion, obtained as described on the next page. Progress which may have ceased under one preparation may reappear with the other.

Tuberculin Therapy. Preparing the Dose.

Pure tuberculin is never used in diagnosis nor in treatment except at the end of a long course of dilutions. The early doses are so small that most tuberculins must be highly diluted. Protected from light and air, most pure tuberculins keep indefinitely. When diluted, they spoil in a few days unless preserved with chemicals. To spare the physician the trouble of making the rather intricate calculations advised with some tuberculins, manufacturers have placed on the market dilutions ready for use. It is doubtful whether these dilutions retain their activity for a long time. It is better to make the dilutions fresh for each day's use.

Koch directs that the dilution be made with 0.8% salt solution with the addition of 0.5% carbolic acid. Such a mixture will keep on ice for several days. When the solution turns turbid, it is unfit for use. With the author's simple method of making the dilutions, these precautions are unnecessary. The dose can be prepared in simple water quickly, easily and cheaply and with sufficient accuracy without the necessity for diluting pipettes or apparatus.

To prepare the dose of old tuberculin, follow the directions described on page 5 for mixing the dose for diagnosis. Every five drops of this solution contains 1 milligram of tuberculin. To obtain 0.1 milligram, make a further dilution of 1 to 10. Every five drops of this dilution contains 0.1 milligram.

In using *bacillus emulsion*, follow the same technique, adding 1 drop of bacillus emulsion from the lip of the bottle to two-thirds of an ounce of water. Shake.

Five drops of this dilution contains .005 milligram of B. E., the author's usual dose.

OLD TUBERCULIN THERAPY.

Method of Koch and Most European Workers.

The author's criticism of this method is that the dose is given too frequently.

Four dilutions are prepared. 1 c.c. of old tuberculin is diluted with 9 c.c. ½% carbolic acid water; 1 c.c. of this with 9 more c.c. carbolic acid water and so on. These dilutions are numbered 1, 2, 3 and 4, and correspond exactly to the homœopathic 1, 2, 3 and 4 decimal dilutions.

The initial dose is the diagnostic dose that has given distinct reaction, say 1 milligram, 1 c.c. of Dilution No. 3. The next dose is withheld until all signs of reaction have disappeared, temperature has fallen to normal and the "general condition is continuously good." The dose is then given every second or third day each dose being double the preceding dose until more violent reaction occurs. Then the increase in dose is more gradual, through Dilution No. 2 and No. 1. The course is ended at 5 c.c. of Dilution No. 1 or 0.5 c.c. of the pure tuberculin. After an interval of three or four months, the patient is again tested with diagnostic doses (Koch's method, page 7) and the course of treatment repeated if necessary.

All signs of reaction are allowed to subside before another dose is given. Koch states that "It is useless to repeat the same dose and a great mistake to give a smaller dose as the smaller dose creates a hypersensitiveness to tuberculin." For the author's criticism of this method, see page 20.

TUBERCULIN THERAPY. LAST METHOD OF KOCH.

Bacillus Emulsion.

Several years ago, the initial dose advised was .005 milligram, obtained by mixing 0.1 c.c. of the bacillus emulsion with 9.9 c.c. of 0.8% salt solution and 1 c.c. of this with 9 c.c. salt solution. Of this 1 to 1000 dilution, 1 c.c. contains .005 milligram. Then the initial dose was reduced one-half, .0025 milligram. Koch's last advice is to carry the dilution stlll further, as follows:

First dilution,	1 to 100;	each c. c. contains 0.05	milligram	bacillary	substance
Second dilution,	1 to 1,000;	each c. c. contains 0.005	milligram	"	"
Third dilution,	1 to 10,000;	each c.c. contains 0.000,5	milligram	"	"
Fourth dilution	1 to 100,000;	each c.c. contains 0.000,05	milligram	"	"
Fifth dilution,	1 to 1,000,000;	each c.c. contains 0.000,005	milligram	"	"

The initial dose last advised is 1 c.c. of the fifth dilution, five one-millionths of a milligram of bacillary substance. If there is no reaction, this dose is increased five-fold every two days, 0.5 c.c. and then 1 c.c. of the fourth dilution. If reaction occurs, the dose is increased more gradually, by 0.2 or 0.1 c. c. through the third and second dilutions and not repeated until the reaction subsides. With sharp reactions the interval is made longer, 6 or 8 days. When the undiluted liquid is reached, the interval is lengthened to 4 to 6 weeks and the injection is divided in several portions for better absorption. When 1 c.c. of the pure emulsion is reached, the course is finished.

In naming these dilutions, there is, to a homœopath, the discrepancy that the first dilution is made according to our centesimal scale; the others on our decimal scale. For the author's criticism of this method, see page 20.

TUBERCULIN THERAPY.

Method of Denys. Bouillon Filtré.

Among the speakers in the therapeutic section of the International Tuberculosis Congress at Washington, in 1908, no one made a more profound impression than Denys, of Belgium, who reported a large number of cases of tuberculosis cured or improved by the use of unheated tuberculin given in truly infinitesimal doses.

Denys employs only bouillon filtré, known as B. F. This is glycerin bouillon in which tubercle bacilli have been grown, the bacilli having been filtered out. It is old tuberculin which has not been concentrated by heat and contains no preserving chemicals. It is notable that this unheated bouillon filtré really gives stronger reactions and requires greater care in its administration than the concentrated old tuberculin, the heat used in concentrating the old tuberculin having diminished its toxic and therapeutic activity.

The features of the Denys method are:

The very minute initial dose;

The extreme watchfulness for even slight signs of reaction;

The importance attributed to the thickening of the skin at the point of injection as part of the reaction;

the care exercised to allow reactions to subside fully before repeating the dose;

the caution in not passing to a larger dose as long as the last dose causes even a slight reaction.

The author believes that the method of Denys is the safest that has yet been devised by a bacteriologist but not as safe or effective as his own method described on page 10.

The time between doses is not long enough. Denys approaches the homœopathic technique by waiting not only until the reaction subsides but also two, three or four days longer. He has not yet realized that improvement will continue not only four days but many days longer if no more medicine is given. Denys also perpetuates that obstinate error of the bacteriologist, the progressive increase of dose. See *A Homœopath's Criticism*, page 20.

Denys' Rules, printed here in condensed form should be studied by everyone who uses tuberculin as a remedy. They are doubly interesting to the homœopath, showing as they do a modern bacteriologist following step by step the path marked out by Samuel Hahnemann one hundred years ago.

Rules of Professor Denys.

Rule 1. Under no conditions, begin or carry out tuberculin treatment without constant control by thermometer.

Classify the patients as febrile and afebrile.

An afebrile case is one in which, under ordinary conditions, the temperature does not rise above 37 C., 98.6 F. Begin treatment at once.

A febrile patient is put to bed for one week, no intellectual work being permitted. If the temperature falls to 37 C., 98.6 F., treat as an afebrile case.

If the fever does not disappear in one week, there is no use in waiting longer. Begin treatment cautiously but keep the patient constantly in bed. To this rule, there is no exception.

Rule 2. The initial dose should be small enough to avoid violent reaction.

In febrile cases, begin with 0.1 c.c. of the weakest dilution, 1 to 10,000,000. In afebrile cases, begin with 0.1 c.c. of the 1 to 100,000. Smaller doses are a waste of time. Larger initial doses risk violent reactions.

The reaction. As in all tuberculin work, the reaction is three-fold, local, focal and constitutional.

The local reaction appears as discomfort at the point of injection or swelling or thickening of the skin. Detect the thickening by pinching a fold of skin at the point of injection and compare with the skin at the corresponding point on the other side of the body.

The focal reaction consists of the well-known aggravation of the tubercular foci.

The constitutional reaction is shown by rise of temperature, headache, loss of appetite or feeling of illness.

Rule 3. Increase of dose should be in proportion to tolerance. It must be determined for each case. Tolerance increases slightly at first; later, much more rapidly.

If there is no reaction, it is useless to repeat the same dose. (With this statement the author does not agree. See page 20).

Increase each dose by 0.1 c.c.; in tolerant cases by 0.25 c.c. On reaching 0.9 c.c. or 0.75 c.c., pass to the next strongest dilution, beginning with 0.1 or 0.25 c.c. of the new dilution and increasing as before, ending with 1 c.c. of the pure bouillon filtre.

The Interval. If there is no reaction, inject twice a week.

In tolerant patients, the result can be attained more quickly by injecting three times a week up to the 1 to 10,000 dilution; then twice a week up to 1 to 1,000.

In tolerant cases, daily injections of the weaker dilutions, 1 to 100,000 and below, may be given, stopping at the least reaction; then twice a week.

Rule 4. Never give a dose during the reaction from a previous dose.

Rule 5. Do not repeat the dose the moment the reaction is over. Allow the patient a period of rest before the next injection, never less than 24 hours. With small doses and slight reactions, 24 hours is enough. With large doses or sharp reactions, wait two, four or even more days. The sharper the reaction, the longer should be the interval.

Rule 6. With weak or short reactions, repeat the same dose. With strong or long reactions, diminish the dose.

A weak reaction is one in which the local reaction is slight and the temperature does not rise more than 1 degree C., 2 degrees F.

A strong reaction is one in which the local or focal or constitutional reaction is sharp and the temperature rises more than 1 degree C., 2 degrees F. With strong reactions, wait at least two days after the reaction has ceased and reduce the dose to one-half or one-third or even less if the reaction is very strong.

A prolonged reaction, more than 48 hours, even though mild, is regarded as a strong reaction. In this case, reduce the dose.

Making the Dilutions.

The dilutions can be purchased in the market with directions for use. However, as there is some doubt of the therapeutic activity of old dilutions, it is better to make the dilutions fresh, as recommended with the other tuberculins.

For dilution, any liquid will serve. Denys uses equal parts peptone-bouillon and sterile glycerin. Sterile water or salt solution is suitable.

There are eight numbers in the series.

No. 8.	Pure bouillon filtré	
7.	Dilution of	1 to 10
6.	”	1 to 100
5.	”	1 to 1,000
4.	”	1 to 10,000
3.	”	1 to 100,000
2.	”	1 to 1,000,000
1.	”	1 to 10,000,000

With a 1 c.c. pipette graduated in tenths, mix 0.1 c.c. bouillon filtré with 9.9 c.c. water. Of this dilution, mix 1 c.c. with 9 c.c. water, giving a dilution of 1 to 1,000 or the homœopathic third decimal.

Mix 0.1 c.c. of this dilution with 99 c.c. water, giving a dilution of 1 to 1,000,000 or the homœopathic sixth decimal.

Mix 1 c.c. of this dilution with 10 c.c. water, giving a dilution of 1 to 10,000,000 or the homœopathic seventh decimal.

The initial dose is 0.1 c.c. or two drops of this seventh decimal dilution, containing one hundred-millionth of 1 c.c. of the original bouillon.

The dilutions can be prepared more simply by making the homœopathic seventh decimal dilution in the usual manner or more rapidly by mixing one drop of the bouillon filtré with two ounces of water, giving the 1 to 1,000. One drop of this dilution in two ounces of water gives 1 to 1,000,000. or the sixth decimal. Ten drops of this sixth decimal with ninety drops of water gives the seventh decimal, of which the initial dose is two drops. Increase the dose by two drops up to eighteen drops; then pass to two drops of the sixth decimal and so further.

Denys has attempted an interesting computation of the size of his initial dose, 0.1 c.c. of the one to ten million dilution or one hundred-millionth of 1 c.c. of the original bouillon.

"99% of the bouillon is water and glycerin. The dose, then, is one-ten-billionth of a gram of dry substance. But the active principle of the dry substance, the bacterial excretions, form only a small part, the greater part being composed of peptone, meat extractives and salts. Thus the dose of microbic excretion must be much less than one ten-billionth part of a gram.

"However, in the treatment of tuberculosis, if one wishes to avoid violent reactions, it is necessary to employ these minute doses. *A priori* one would deny that they had any activity. Nevertheless, in sensitive tuberculous patients, they have undeniable effects." Shade of Hahnemann!

A HOMŒOPATH'S CRITICISM OF TUBERCULIN THERAPY.

Tuberculin therapy by any method is primarily a question of early diagnosis. With early recognition, many cases of tuberculosis will get well on any intelligent treatment. Moderately advanced cases of tuberculosis are not cured by any treatment. The combating of the associated infections may be one step toward success. However, like the cure of cancer, the cure of moderately advanced tuberculosis is yet an unsolved problem.

The first lesson that the tuberculin therapeutist learns is that the usefulness of tuberculin is limited to early cases; the next, that it must be used in very minute doses. Whatever be the principle by which tuberculin acts, there is no doubt that it resembles a homœopathic remedy in this, that a large dose will aggravate and a small dose will cure. The early homœopaths who worked at the problem of curing a chronic disease with a remedy that would aggravate the disease found that:

the dose must be extremely small, too small to aggravate the symptoms;

the dose should not be repeated until improvement from the previous dose has ceased.

After many years, the bacteriologist has learned to use small doses but he has not yet learned the damage he is doing in early tuberculosis by repeating the dose every second or third day. When, in 1890, Koch announced that his newly-found tuberculin would cure tuberculosis, Burnett, the homœopath, who had been working with bacillinum since 1885, predicted that tuberculin would curc tuberculosis but that Koch's dose would be found too large and too frequently repeated. Naturally, the opinion of the obscure homœopath was unnoticed but it is now universally admitted that the great bacteriologist was wrong and the homœopath right. The bacteriologist now uses a dose so minute that it has never been calculated (See page 19, Denys) and he is as cautious as a high-potency homœopath to avoid medicinal aggravation from these truly infinitesimal doses.

The author believes that the homœopath has another lesson to teach the bacteriologist, to with-hold the next dose until improvement from the preceding dose has ceased. The bacteriologist has learned to wait for the subsidence of the aggravation and Denys has an inkling of the truth when he advises delaying the next dose for a few days after the aggravation subsides. One of Wright's pupils has noticed steady improvement in the blood for six weeks after a single dose of tuberculin and advises giving no more while improvement continues; but these are isolated instances. The majority of tuberculin workers inject a new dose as soon as the aggravation from the preceding dose has subsided. The author believes this to be bad practice. *The dose should not be repeated as long as improvement continues*, the best index to improvement being progressive increase in the patient's weight.

The author believes that the progressive increase in dose is another error in the use of tuberculin. In immunizing a healthy animal against infectious disease, it is necessary to begin with small doses and to increase the dose to the toxic point or beyond it; but the bacteriologist has carried the principle of animal immunizing over into therapeutics, unwarrantably, it seems to him. The author believes that immunizing a healthy animal and curing a sick one proceed on different principles. The very cornerstone of bacterial immunization, vaccination, is useless to cure small-pox. Tetanus and rabies can be prevented by immunizing but the immunizing remedy is powerless to cure. We homœopaths are no novices in treating disease with a small dose of a drug that will aggravate the disease and we make many cures by repeating the same dose. Malaria and syphilis have been cured for centuries without recognizing any such principle as progressive increase in dose. It is acknowledged by all that the early large doses of tuberculin have many deaths to answer for. They have been discarded. The author believes that the frequent repetition and the progressive increase in dose should also be banished from tuberculin therapeutics.

GLOSSARY OF TUBERCULINS.

ALBUMOSE-FREE T. Tuberculin made from bacilli grown on media free from albumose and peptone, on the theory that it is the albumose in the tuberculin that causes the reaction. Recommended for sensitive patients who react sharply to tuberculin. The theory is probably incorrect. Bacillus emulsion and tuberculol-B contain no peptone but give sharp reaction in suitable doses.

ANTIPHTHISIN of Klebs. See TUBERCULOCIDIN.

A. T., ALT TUBERKULIN, old tuberculin.

BACILLUS EMULSION, B. E. Masses of tubercle bacilli triturated to the point where their bodies are mechanically broken up and the bacilli destroyed. They are not treated with heat or chemicals. ½% suspension of this bacillary substance in equal parts glycerin and water.

BERANECK'S T. Old tuberculin made from bacilli of standard virulence is precipitated by alcohol and the precipitate mixed with equal parts of an extract of the bacillary bodies made with orthophosphoric acid. Free from albumose and peptone. Weak activity and expensive.

BOVINE T. Any tuberculin made from bacilli of bovine tuberculosis. See PERLSUCHT T.

BOUILLON FILTRÉ. B. F. of Denys. Glycerin-bouillon in which tubercle bacilli have been grown as in preparing old tuberculin and the bacilli filtered out through porcelain. It differs from old tuberculin in not being concentrated or exposed to heat.

CALMETTE'S TEST. See OPHTHALMO-REACTION.

CALMETTE'S T. Old tuberculin of bovine origin unheated but precipitated by alcohol and ether and redissolved to eliminate "extraneous matter" and isolate the "curative principle."

CONJUNCTIVAL REACTION. See OPHTHALMO-REACTION.

CUTI-REACTION. See SKIN REACTIONS, page 8.

DENYS' T. See BOUILLON FILTRÉ.

DETRE'S TEST. Skin tests made simultaneously with old tuberculin of human and of bovine origin, on the theory that the intensity of the respective reactions demonstrates which type of bacillus affects the patient. In practice it is a failure.

ENDOTIN. TUBERCULINUM PURUM. The result of an effort to isolate the "curative principle" and exclude the extraneous matter by treating old tuberculin with alcohol, xylol, ether, chloroform, decanting, centrifugalizing and finally treating with mild alkali. It is the feeblest of the tuberculins, probably losing much of its activity by these chemical manipulations.

ESCHERICH'S REACTION. The local reaction at the point of injection of old tuberculin.

EYE REACTION. See OPHTHALMO-REACTION.

HUMAN T. Any tuberculin made from bacilli of human origin.

I. K., IMMUN KOERPER of Spengler. A preparation of red blood corpuscles of animals that have been immunized to tuberculosis. Spengler claims that the immune bodies are made in the red blood cells and only escape later into the serum. Claimed to confer both passive and active immunity.

KLEBS' T. See TUBERCULOCIDIN.

KOCH'S T. Any one of the three tuberculins, OLD T., T. R. and B. E.

LANDMANN'S T. See TUBERKULOL.

LAUTIER'S test. Prolonged application to the skin of cotton wet with a 1% solution of old T. Reaction of redness in 24 to 48 hours. Inexact.

LIGNIERE'S test. Shave the skin. Rub 5 drops of old tuberculin in well for 2 minutes.

MARAGLIANO'S SERUM. Serum of horses that have been immunized with special extracts of tubercle bacilli. Confers passive immunity.

MARMOREK'S SERUM. Serum of horses that have been immunized with extracts of very young bacilli grown on special media. Confers passive immunity.

MIXED T. OF WOLFF-EISNER. Mixture of old tuberculin and bacillus emulsion.

MORO REACTION. Percutaneous reaction. A skin reaction following rubbing into the skin a 50% old tuberculin-lanolin ointment. See page 9.

NASTIN. Fat extracted from the lepra bacillus. Immunizes against the lepra bacillus. TUBERCULO-NASTIN. An analogous fatty substance extracted from tubercle bacilli; supposed to produce immunity to the attack of tubercle bacilli.

NEUTUBERKULIN. Both T. R. and B. E. were successively called Neutuberkulin.

OLD T, KOCH. A glycerin-bouillon culture of tubercle bacilli concentrated by heat to one-tenth volume and filtered. It is an aqueous-glycerin extract of tubercle bacilli and their excretions. It contains no bacilli.

OPHTHALMO-REACTION. Redness and swelling of the conjunctiva that follows about 24 hours after the instillation into the eye of a 1% solution of old tuberculin. Introduced independently by Calmette and Wolff-Eisner. Dangerous. See page 4.

ORIGINAL T. Old T., Koch.

OXYTUBERCULIN of Hirschfelder. Old T. treated with hydrogen dioxid.

PAQUIN'S SERUM. Serum of horses immunized with tubercle bacilli of weak virulence.

PERLSUCHT T. BOVINE T. Any tuberculin made from bacilli of bovine tuberculosis. Introduced by Spengler on the theory of antagonism between human and bovine bacilli, a theory that experience does not support.

VON PIRQUET'S REACTION. See SKIN TEST, page 8.

ROSENBACH'S T. Old tuberculin prepared from bouillon in which the tubercle bacilli have been overgrown by the fungus *tricophyton holosericum album.* This fungus is supposed to destroy the "toxic principles" of tuberculin and release the "curative principles;" probably a fallacy.

VON RUCK'S T. A watery extract of tubercle bacilli that have been first washed in water and extracted with alcohol and ether to free them from the extraneous substances of the culture medium and the bacillary bodies.

SKIN REACTION. See page 8.

T. ALKALINUM. T. A. One of Koch's early tuberculins, soon discarded. An extract of tubercle bacilli made with decinormal sodium hydrate. Causes suppuration at the point of injection.

T. CL. Calmette's tuberculin.

TUBERCULOCIDIN of Klebs. T. C. Old tuberculin treated with alcohol and bismuth to eliminate the "toxic principle" and extract the "tuberculocide principle." ANTIPHTHISIN of Klebs is a similar effort, using sodium-bismuth iodid in acetic acid. Both preparations are fanciful and long discarded.

T. O. T. OBERE SCHICHT. The watery extract of tubercle bacilli discarded in making T. R. It corresponds to B. F. or to old tuberculin before concentration. Never in general use.

TOA. TUBERCULIN-ORIGINAL-ALT. Koch's old tuberculin.

TULASE. TULASELAKTIN, of von Behring. The method of preparation is secret. Also, TUBERKULOSE, for prevention of tuberculosis in cattle.

T. PURUM. See ENDOTIN.

T. R., T. RÜCKSTAND. The sediment left when triturated tubercle bacilli are shaken with water and centrifugalized. In discarding the water, T. O., the intention is to discard the water-soluble "toxic principles." T. R. is a water-glycerin emulsion of this sediment. It is one of the most expensive tuberculins. It has been largely replaced by B. E.

TUBERKULOL-A. Culture broth of various strains of tubercle bacilli concentrated in vacuum without heat.

TUBERKULOL-B. A watery extract of tubercle bacilli extracted fractionally at progressively higher temperatures.

WOLFF-EISNER'S MIXED TUBERCULIN. A mixture of old tuberculin and bacillus emulsion. The object is to obtain all the active principles.

URINE.

SPECIFIC GRAVITY.

There is no normal specific gravity of urine.

In health, the specific gravity varies from hour to hour. Abundant drinking of liquids, nervous excitement or exposure to cold increase the amount of urine and correspondingly lower the specific gravity. Profuse sweating, as in hot weather or from exercise, or diminution in the amount of liquids taken, concentrate the urine and raise the specific gravity.

The specific gravity of urine furnishes two points of information.

It indicates whether the urine is concentrated or dilute.

When the 24 hour quantity is known, the specific gravity of the mixed urine furnishes a rough estimate of the total solids eliminated in 24 hours.

TOTAL SOLIDS.

The last two figures of the specific gravity are multiplied by $2\frac{1}{3}$ and divided by 1000. The result is the number of grammes of solids in 1 c.c. of urine. This figure, multiplied by the number of c.c. passed in 24 hours gives the total urinary solids in grammes.

Example: Specific gravity 1.021 Quantity in 24 hours, 1200 c.c.
$21 \times 2\frac{1}{3} = 49 \div 1000 = .049$ grammes in 1 c.c.
$.049 \times 1200$ c.c. $= 58.8$ grammes of solids in 24 hours.

This figure is only approximate and accurate only when the fluid urine is at or near the "normal" 1200 c.c.

When the fluid urine exceeds 1600 c.c., the resulting figure for total solids is too high. Below 900 c.c., the figure for solids may be too low.

The normal standard of total solids is usually placed at 50 to 60 grammes but varies with the body weight. In the individual, the variation is wide, depending chiefly on the amount and character of the food taken and, to a less extent, on exercise.

Formerly we attached great importance to knowing the total solids and total urea as indices of renal excretory power and many false conclusions were drawn in this way. Often we are puzzled to see individuals with one-half or even one-third of the normal elimination of solids live year after year in apparent health while occasionally a patient with "normal" elimination suddenly dies uræmic. Studies in metabolism show that the amount of urinary solids is directly dependent on the amount and character of the food taken. Their amount indicates nothing unless the amount and character of the food is taken into account. When, as is usually the case, the man who examines the urine never sees the patient, the figure of total solids is meaningless to him.

Calculations of urea and chlorides from the specific gravity are inaccurate and misleading.

REACTION.

The reaction of healthy urine is acid, varying in degree from hour to hour. The acidity of urine is not due to uric acid. It is due to the acid sodium phosphate. A precipitate of uric acid is merely an indicator of acidity and indicates nothing of the amount of uric acid present. All urine contains uric acid. When the urine is highly acid, it no longer holds its uric acid in solution. When the urine is less acid or alkaline, the uric acid remains in solution. See Uric Acid, page 48.

The acidity of urine can be determined and recorded as with gastric juice by titration with decinormal sodium hydrate solution and phenolphthalein but this figure of acidity is far from exact and is of no practical value in diagnosis or treatment.

TESTING FOR ALBUMIN.

Clearing the Urine.

The urine must be clear and. fresh.

If the freshly-passed urine is turbid, the turbidity is usually due to pus, mucus, blood, urates or phosphates, all of which can be filtered out by fine-grained filter paper, especially if the urine is allowed to cool for half an hour for the mucus to precipitate.

Keep on hand a package of three inch filter-papers. Roll the filter-paper into a small cone, place it in the top of the test tube with a match alongside to keep an opening for the exit of air, and filter the urine directly into the test tube.

Turbidity of fresh urine that is not removed by filter-paper is due to bacteria which pass through the filter-paper. These are cases of true bacteriuria but should be verified by demonstrating the bacteria microscopically in a drop of freshly-passed urine.

There is no satisfactory way of clearing such urine nor of clearing old specimens which have become turbid from bacterial growth. In fact, it is simply impossible to detect a trace of albumin in urine either fresh or old that is turbid from bacterial growth. A further source of error is that all such urines become more turbid by boiling and acidulation whether or not they contained albumin when fresh.

When albumin is found to be present in quantities of more than a trace, clearing the urine is unnecessary; but, with unknown specimens, or where, as in chronic interstitial nephritis, the detection of a trace of albumin is important, the only safeguard against error is to secure fresh, clear urine for the test. In the case of women, to avoid the trace of albumin often contained in the vaginal secretion, it is better to remove the urine by catheter.

If a fresh specimen cannot be obtained, the next best procedure is to clear by the old method of Hoffmann and Ultzmann. Warm the urine with one-fourth volume liquor potassæ and filter. If the filtrate is clear, test for albumin as usual.

This method may remove some of the albumin or all of it if only a trace is present. Another defect is that after such a treatment, a specimen turbid from bacterial growth may give a positive test for albumin even though there was no albumin in the urine when fresh.

Hoffman and Ultzmann direct further that if the urine is not cleared by liquor potassæ and filtration, add a few drops magnesian fluid, warm and filter again. This method is misleading for it removes small amounts of albumin and reduces large amounts.

The worst method of all is that recommended in most text books of mixing the urine with magnesium oxide or with the fine earth in which bromin bottles are packed and filtering. This procedure clears the urine perfectly but takes all the albumin out of it even up to large amounts.

The requisites for a test for albumin are that it should be convenient; it should detect faint traces; of faint traces, it should differentiate between the comparatively insignificant nucleo-albumin and the more serious serum-albumin.

The author rejects the nitric acid contact test because it fails to show traces of albumin and because his experience shows that physicians often interpret it incorrectly. For the physician in general practice, there is the further disadvantage of staining the fingers with the nitric acid.

The Esbach picric acid solution and the ferrocyanide solution fail to show faint traces and they precipitate alike nucleo-albumin and serum-albumin. They should be used for quantitative testing only.

The mercurial solutions, Spiegler's and Tanret's tests, cause cloudiness in nearly every urine examined. In clinical work, they are misleading and impractical.

The routine test for albumin that is simple, rapid, accurate; that differentiates between traces of nucleo-albumin and serum-albumin; that is delicate enough for interstitial nephritis but not so delicate as to be impractical, is the modification of the heat test described on the next page.

TEST FOR ALBUMIN.

Required: 3 test tubes
Filter-paper, 3 inch (no funnel required)
1 match (inserted between filter-paper and test tube for exit of air)
Acetic acid, 36% U. S. P.
Sodium chloride, saturated watery solution.
Bunsen or alcohol flame.

Test: Into test tube No. 1, filter 1 inch of urine; set aside.

Into test tube No. 2, filter 2 inches of urine, add ¼ inch saturated solution NaCl, and five drops of acetic acid. Shake and pour one-half into test tube No. 3.

Boil test tube No. 1 and add 5 drops of acetic acid.

Boil test tube No. 2; add nothing.

Leave test tube No. 3 unboiled for comparision with the boiled urine.

Interpretation: Any opacity or precipitate in tube No. 1 is either serum-albumin or nucleo-albumin, or both together. Any opacity or precipitate in tube No. 2 is serum-albumin alone. Nucleo-albumin is held in solution.

If there is opacity or precipitate in tube No. 1 and not in tube No. 2, the albumin present is nucleo-albumin, which, in a general way, indicates the milder catarrhal processes rather than a true nephritis with escape of serum-albumin through the glomeruli and renal tubules.

Opacity or precipitate in both tubes No. 1 and No. 2 indicates the presence of serum-albumin, either from a nephritis or a severe inflammation of any urinary mucuous membrane.

In dealing with faint traces of albumin, a slight opacity is detected by holding the three tubes side by side against a dark background, a dark curtain or a dark window frame. A slight opacity in tube No. 1 or No. 2 is easily detected when compared with tube No. 3 though it may escape notice if looked at alone.

If there is marked discrepancy between tubes No. 1, and No. 2, it is possible that too much acetic acid was added to tube No. 2. Repeat the test for confirmation, taking care to add no more than five drops of acid. Do not use acetic acid stronger than 36% U.S.P. as the stronger acid is apt to hold the albumin in solution.

PEPTONE AND THE ALBUMOSES.

These substances are many, their nature is not fully understood, their behavior to reagents is variable, their significance is unknown, their presence is probably merely accidental and they are rarely present in amount sufficient to interfere with the usual tests for albumin.

The physician will do well to disregard them unless he is prepared to master some abstruse organic chemistry.

QUANTITATIVE TESTS FOR ALBUMIN.

In quantitative estimation of albumin, hair splitting accuracy is unnecessary. The amount of albumin in the urine varies so much from day to day that only wide variations have any significance of improvement or aggravation of the disease.

Where a suitable centrifuge is available, Purdy's centrifugal method is most rapid and convenient. Otherwise, use Esbach.

Neither of these quantitative tests show faint traces of albumin. They should not be used at first to detect albumin but only to estimate the quantity after its presence has been detected by boiling.

ESBACH'S QUANTITATIVE TEST.

Required: Esbach's picric acid reagent
Graduated Esbach test tube and cork

Test: Fill graduated tube with urine up to the mark U and add the reagent to mark R. Cork. Mix by inverting several times and let stand 24 hours.

Interpretation: After 24 hours, read off the grammes per litre on the scale.

Grammes per litre are 1 to 1000. To obtain the percentage of albumin, 1 to 100, move the decimal point one point to the left.

2. grammes per litre = 0.2%

ESBACH'S REAGENT.

FORMULA

Picric acid	5 grammes.
Citric acid	10 grammes
Distilled water	500 c.c.

Mix and filter.

PURDY'S CENTRIFUGAL QUANTITATIVE TEST FOR ALBUMIN.

Required: 10% watery solution of potassium ferrocyanide.
Acetic acid.
Centrifugal tube of 15 c.c. capacity, the lowest c.c. graduated in 0.1 c.c.; the others in quarter c.c.
Purdy's centrifuge or its equivalent. The arm must measure from the center of the axle to the tip of the tube, 6¾ inches. The centrifuge must revolve its load of two tubes at 1500 revolutions per minute.

Test: To 10 c.c. filtered urine in the centrifugal tube, add 3 c.c. ferrocyanide solution and 2 c.c. acetic acid.
Mix by inverting the tube several times and set aside 10 minutes for complete precipitation.
Centrifugalize for 3 minutes at 1500 revolutions, balancing with a tube of water or preferably another albumin test.

Interpretation: Read off the percentage of albumin according to Purdy's table. Every cubic centimeter of the precipitate corresponds to one grain of albumin to the ounce of urine, 2 grammes per litre or 0.2 of 1%.

Solution potassium ferrocyanide 10%.

Potassium ferrocyanide	4 drams
Distilled water	4 ounces

Mix and filter.

TESTING FOR SUGAR.

There are still among us simple souls who recognize sugar in the urine from high specific gravity alone. These need to be cautioned not only that urines of high specific gravity may be merely concentrated and contain no sugar but also that urines of the very usual specific gravity of 1.025 may contain sugar in abundance.

In emergencies, the once popular method of tasting the urine for sugar may be adapted to the modern palate by evaporating a few drops of urine on a hot stove lid and tasting the resulting sugar. The experienced finger will often recognize the stickiness of such urine where it has dried about the neck of the bottle.

The simplest chemical test is to boil the urine with equal parts liquor potassæ or liquor sodæ. If much sugar is present, the mixture turns brown or even black and the addition of a few drops of nitric acid will evolve the odor of burnt sugar or caramel. The defect of this test is that nearly all urines darken somewhat when boiled with an alkali, especially dark-colored urines. The examiner is in danger either of finding sugar in all dark-colored urines or of overlooking a small amount of sugar when present. These small amounts of sugar, overlooked by the potash test, are readily detected by one of the many copper tests.

All copper tests for sugar have this defect that urines containing much uric acid or its related substances or oxalate of lime or coloring matter, may change the blue color to a green or give a red precipitate which is difficult to distinguish from a trace of sugar. Of the various copper tests, Fehling's is the most confusing in this respect, Purdy's the least.

Purdy's test is an adaptation of Pavy's modification of Fehling. The late Dr. Purdy preferred Haines' solution for the routine work of detecting sugar and insisted that his test was designed only for the quantitative estimation of sugar after it had been detected by Haines' or other solution. The author worked with Haines' solution for several years but met the same difficulty as with other copper tests in recognizing a trace of sugar. This difficulty is solved by the Purdy test with its clear end-reaction of colorless liquid that can easily be proven by holding beside it a test tube of water.

The author calls this his application of the Purdy test, not wishing to attribute to the late Dr. Purdy the use of his solution for qualitative testing, of which he distinctly disapproved. However, having used it in this way for over ten years and in the examination of nearly ten thousand urines, the author believes himself qualified to endorse it as the most satisfactory of qualitative tests for sugar.

For routine work, use the Purdy copper test, page 36

For quantitative estimation, use fermentation, page 37

All urines containing sugar should be tested also for diacetic acid and acetone, pages 40 and 41.

THE AUTHOR'S APPLICATION OF THE PURDY COPPER TEST FOR SUGAR.

Required: Purdy copper solution
1 test tube
Bunsen or alcohol flame

Test: Pour 1 inch of Purdy's copper solution in a test tube.
Add ten drops of urine and boil.

Interpretation: If no sugar is present the fluid remains blue; or, if it becomes paler or greenish, it still retains a blue tint.
If a little sugar is present, the fluid becomes as colorless as water.
If much sugar is present, the fluid changes rapidly from colorless to yellow or brown.

If in doubt of the complete discoloration, examine test beside a test tube of water against a white background. The faintest tint of blue or yellow will be seen easily.

Formula.

Solution No. 1.	Cupric sulphate	2.38 grammes
	Distilled water	100 c.c.
	Dissolve by gentle heat	
	Add glycerin c.p.	19 c.c.
Solution No. 2.	Potassium hydroxid	11.8 grammes
	Distilled water	100 c.c.

Mix No. 1 and No. 2. When cool, add aqua ammonia fortior, 175 c.c.
Add enough distilled water to make exactly 500 c.c.

QUANTITATIVE ESTIMATION OF SUGAR BY FERMENTATION.

Required: 1 cake compressed yeast
2 fermentation tubes, graduated for sugar testing,
2 clean test tubes.

Test: In one-half ounce of urine in a test tube, dissolve one-sixteenth of a cake of yeast, by shaking.

In one-half ounce of water in the other test tube dissolve an equal quantity of yeast.

Let the test tubes stand a few minutes till all bubbles rise.

Pour each into a fermentation tube. Keep at room temperature for 24 hours.

Interpretation: At the end of 24 hours, read off the percentage of sugar or grains per ounce.

The mixture of yeast and water is a control tube to guard against error, as some yeasts give off gas. Gas in the control tube has come from the yeast. This should be subtracted or the test repeated with better yeast.

If the urine contains much sugar, the resulting gas will drive the urine down beyond the scale. In this case, it should be diluted, one dram of urine to three drams of water and the result multiplied by four; or one dram of urine to seven of water and the result multiplied by eight.

It is convenient to scratch the test tubes at the point where they contain enough urine to fill the fermentation tubes. Such marked test tubes are usually supplied with the fermentation tubes.

QUANTITATIVE ESTIMATION OF SUGAR BY PURDY'S COPPER SOLUTION.

Purdy's copper solution may be employed for quantitative testing as originally designed. The author used this method for several years but found its technique unnecessarily complex. He prefers the simpler and sufficiently accurate estimation by fermentation described on page 37.

Required: Purdy's copper solution (Formula on page 36.)
A five-ounce beaker or flask
A 10 c.c. burette graduated in tenths
Bunsen or alcohol flame
Burette stand with clamp for burette and ring for flask
Wire gauze, to prevent flame cracking beaker.

Test: Fix burette in clamp and fill with urine to be tested
Measure 35 c.c. of the copper solution into the beaker
Place the beaker over the flame, resting on the gauze and bring the copper solution to a boil.
Drop the urine from the burette into the boiling copper solution until the color begins to fade; then more slowly until the fluid is colorless.

Interpretation: The amount of urine required to discharge the blue color from 35 c.c. of the copper solution contains exactly 0.2 gramme sugar. The amount of sugar present is easily calculated from the accompanying table.

If the amount of sugar is large, more than 5%, better results are obtained by diluting the urine with three volumes water and multiply the result by 4.

TABLE FOR QUANTITATIVE ESTIMATION OF SUGAR BY PURDY'S COPPER SOLUTION.

Degrees of the burette C.C.	Percentage of sugar	Grains of sugar per fluid oz.	Degrees of the burette C.C.	Percentage of sugar	Grains of sugar per fluid oz.
0.4	5.	24.	2.3	0.87	4.2
0.45	4.44	21.3	2.4	0.83	4.
0.5	4.	19.2	2.5	0.8	3.8
0.55	3.64	17.5	2.6	0.77	3.7
0.6	3.33	16.	2.7	0.74	3.6
0.65	3.08	14.8	2.8	0.72	3.5
0.7	2.86	13.7	2.9	0.7	3.4
0.75	2.67	12.8	3.	0.66	3.2
0.8	2.5	12.	3.25	0.61	2.9
0.85	2.35	11.3	3.5	0.57	2.7
0.9	2.22	10.7	3.75	0.53	2.5
0.95	2.1	10.1	4.	0.5	2.4
1.	2.	9.6	4.25	0.47	2.3
1.2	1.66	8.	4.5	0.44	2.1
1.3	1.54	7.4	4.75	0.42	2.
1.4	1.43	6.9	5.	0.4	1.9
1.5	1.33	6.4	5.5	0.36	1.7
1.6	1.25	6.	6.	0.33	1.6
1.7	1.18	5.7	6.5	0.31	1.5
1.8	1.11	5.3	7.	0.29	1.4
1.9	1.05	5.	7.5	0.27	1.3
2.	1.	4.8	8.	0.25	1.2
2.1	0.95	4.6	9.	0.22	1.1
2.2	0.9	4.3	10.	0.2	1.

ACETONE.

The urine must be fresh. All acetone tests are more delicate if made with the distillate.

Required: Liquor potassæ
Gram's solution of iodine (Formula on page 69).
1 clean test tube.
If the urine is distilled,
Small distilling flask
Bunsen or alcohol flame.

Test: To a test tube two-thirds full of fresh urine or the distillate, add one-half inch liquor potassæ and one-half inch Gram solution of iodin. Shake.

Interpretation: If acetone is present, iodoform is formed in the mixture.
Detect by its odor or by a yellowish precipitate of iodoform crystals. Under the microscope, the crystals are seen to be arranged in tiny rosettes.
Gently heating the mixture intensifies the odor.
If acetone is abundant, the iodoform precipitate appears promptly and in abundance.
If acetone is scanty, the precipitate is slight and may require from 3 to 12 hours.

DIACETIC ACID.

Required: 10% watery solution of ferric chloride
2 clean test tubes
Filter-paper—3 inch
Bunsen or alcohol flame.

Test: To a test tube two-thirds full of fresh urine, add 5 drops ferric chloride solution.

Interpretation: A dark red or claret color indicates the presence of diacetic acid.
Often the color is disguised by a heavy precipitate of phosphates.

In this case, add more ferric chloride as long as a precipitate forms.

Filter and test the filtrate by adding a few drops more ferric chloride.

If the color is due to diacetic acid, it will fade on boiling or will not appear in urine that has been boiled.

Salicylic acid, aspirin, carbolic acid and antipyrin give a similar reaction but the color does not fade on heating and persists in urine that has been boiled.

10% Solution Ferric Chloride.

Ferric chloride	1 dram
Distilled water	1 ounce

Dissolve and filter into dropping bottle.

INDOXYL SULPHATE (INDICAN).

The importance of indicanuria has been over-estimated. Indicanuria is not nearly as frequent as a reader of medical literature would suppose. As an index of intestinal putrefaction or of auto-intoxication, indicanuria is irregular and unreliable.

In a case of known intestinal obstruction, excess of indican locates the obstruction in the small intestine rather than the colon.

All normal urine contains a small amount of indican.

Testing for indican is apt to be unsatisfactory. It is an elusive substance, unstable and easily assumes forms difficult to recognize by any test.

OBERMEYER REAGENT.

Ferric chloride........................ 4 grains
Strong hydrochloric acid.................. 4 ounces
Mix.

SOLUTION PLUMBIC ACETATE.

Plumbic acetate......................... 1 ounce
Water ....4 ounces
Mix.

INDOXYL SULPHATE (INDICAN).

Obermeyer Test.

Required: Obermeyer's reagent
Chloroform c.p.
Solution plumbic acetate
2 test tubes and 1 cork.

Test: Precipitate a test tube of urine with one-fifth volume plumbic acetate solution.
Filter 3 inches of this urine into the other test tube
To the filtrate add an equal volume Obermeyer, cork the tube and mix by inverting several times.
Add one-half inch chloroform and invert three times
Set aside for the chloroform to precipitate

Interpretation: Obermeyer oxidises the indoxyl to indigo blue, which is taken up by the chloroform.
Excess of indican gives the chloroform a deep blue color.
With normal urine, the chloroform is colorless or has a faint blue tint.
If the blue color does not appear, set aside half an hour for further oxidation. Then invert again several times and let the chloroform settle to the bottom.

BILE PIGMENT.

The demonstration of bile pigment in the urine is useful to verify a diagnosis of jaundice. Jaundice is sometimes confused with other pigmentations of the skin, the observer neglecting to remember that, in jaundice, the white of the eye is always yellow and the urine is always colored by the bile. In the absence of these two symptoms, a yellow pigmentation of the skin is not jaundice.

Bile is represented in the urine by the bile pigments and the bile acids. The test for the bile acids is too complicated for clinical use. Demonstration of the bile pigment suffices for a diagnosis of jaundice.

Urine containing bile is always dark-colored, golden brown to reddish brown or even black. On shaking the urine, the foam is yellow.

Bile pigment is recognized during the microscopic examination of the urinary sediment. Corpuscles, epithelia, casts, cotton fibers or any other stainable elements are colored bright yellow.

TEST FOR BILE PIGMENT.

The Simplest Test is that of Trousseau.

Required: Gram's solution of iodin or iodin tincture
2 test tubes.

Test: Into one test tube, pour an inch of urine
In the other test tube, dilute the iodin with water until it is the same color as the urine
Overlie the urine with the iodin solution.

Interpretation: A green ring at the junction of the fluids indicates bile pigment.

The iodin contact test sometimes fails; in which case use

Gmelin's Test.

Required: Nitric acid
1 test tube

Test: To 1 inch nitric acid in the test tube add a bit of match-stick;
Boil, to obtain nitrous acid;
Overlie the acid with an inch of urine.

Interpretation: A green ring at the junction of the fluid indicates bile.
The bilirubin of the bile has been oxidized to biliverdin.
Below the green there may appear successively blue, violet, red and yellow, representing different stages of oxidation of the bilirubin.

The test may be modified by touching a drop of the acid to filter-paper through which a quantity of the urine has been filtered. The same play of colors around the acid drop, indicates bile pigment.

UREA.

Nitrogenous waste, leaves the body chiefly as urea. Nitrogenous waste comes partly from the tissues but chiefly from nitrogenous food.

The medical profession must unlearn some of its most cherished beliefs about urea as an index of health or of functional activity of the kidneys. Kidneys far advanced in nephritis, especially interstitial nephritis, may eliminate urea in large amounts. On the other hand, an astonishingly low figure of urea may persist for many months with no uræmic accidents and even with good health.

The normal amount of urea is usually stated to be 10 grains to the ounce, 0.02 gramme to the c.c. or 2% and the 24 hour elimination 30 grammes. There really is no normal figure for total urea. At present, this is a question for the physiological chemist and student of metabolism rather than the practicing physician.

The percentage of urea as entered on bedside charts is mean ngless.

The only observation of urea that is worth recording is the amount passed in 24 hours. Even this figure has little significance unless accompanied by the body weight, the amount and kind of food taken and an estimate of the amount of urea that would be expected under these circumstances. In general practice, these calculations are impracticable. It is better to disregard the percentage or the amount of urea rather than draw misleading conclusions.

TEST FOR UREA.

The ureometers are graduated either in grammes to the liter or grains to the ounce. The graduation preferred should be stated when purchasing.

Required: Doremus ureometer, preferably with foot.
1 c.c. pipette, supplied with the ureometer.
Saturated solution sodium hydroxide in water.
Bromin c.p.

Test: Fill the long arm of the ureometer to mark = with the sodium hydrate solution.
Add 1 c.c. bromin.
Mix by inverting.
Add water to fill the long arm of the ureometer around the bend. Mix.
With the pipette, discharge 1 c.c. urine slowly into the long arm so that the resulting nitrogen gas gathers at the top of the tube.

Interpretation: The nitrogen gas gathers at the top of the tube and forces the liquid downward. By the volume of the gas, read off on the scale the grains to the ounce or the grammes to the c.c. Multiply by the number of ounces or c.c. of fluid urine passed in 24 hours.

URIC ACID.

The importance of uric acid as a factor in disease has been absurdly exaggerated. The amount eliminated is small, varying from 0.2 to 1.2 gramme in twenty-four hours. Uric acid is not toxic and is probably blameless of most of the ills attributed to it. It is probable that all uric acid is an end product of the disintegration of nuclei, either those of the body tissues or those of animal food rich in cells. As with all the normal ingredients of urine, the older studies of the elimination of uric acid are faulty in not distinguishing between that which comes from the tissues of the body and that derived from food.

In this clinic, no attention is paid to the amount of uric acid eliminated. A sediment of uric acid is held to indicate an over-acid urine, nothing more. Like urine containing a sediment of oxalate of lime, such urine is associated in some way with those irregular pains in muscles and joints that we call rheumatic; but there is no evidence that the uric acid accumulates in the blood or tissues except in true gout.

The appearance of a sediment of uric acid visible to the naked eye or under the microscope does not mean that the urine contains an excess of it. The only way to determine an excessive elimination of uric acid is to make a quantitative chemical estimation of the amount eliminated in twenty-four hours. In this clinic, this analysis is not made both because the only accurate methods of analysis are long and complicated and because, when obtained, the figure is of no value in diagnosis or treatment.

Neither the appearance of uric acid as a sediment in the urine nor the amount of uric acid passed in 24 hours gives any clue to the amount of uric acid in the blood. This can only be determined by quantitative analysis of the blood-serum itself. There is no simple and accurate method of doing this. Moreover, the work that has been done on the blood-serum by the physiological chemist has failed to reveal any constant relation between the amount of uric acid in the blood-serum and any definite disease except leukæmia, in which an immense number of leucocytes rich in nuclein are produced and destroyed. It is illuminating to note that leukæmia with its blood-serum rich in uric acid far beyond anything observed in gout or in the so-called "uric acid diathesis" presents none of the symptoms so popularly attributed to uric acid and no deposit of urates in the tissues as in gout.

In gout, the observations of the blood-serum are conflicting. The lesion of gout is a deposition of urates in the gouty tissue but it is an error to assume that this deposition implies an excess of urates in the blood. Like calcification, the precipitation of the urates from the blood-serum may be determined by a local process akin to fermentation without regard to the abundance or scarcity of the urates in the blood.

THE INORGANIC SALTS.

Chlorides, Phosphates and Sulphates.

Like total solids and urea, the inorganic salts of the urine are closely related to the amounts taken as food, modified by the power of the body to retain them for long periods or to excrete them in excess in accordance with laws yet not understood.

The following isolated observations are of interest but of no great value in diagnosis or treatment:

In some cases of pneumonia, the urinary chlorides are very scanty, returning with resolution. In such cases, the return of the chlorides in the urine is of good prognosis. Chlorides are scanty in cases of diarrhoea, vomiting and dropsical effusion, probably because considerable amounts of chlorides are lost to the body in these discharges and effusions. Calculated as sodium chloride, the normal elimination of chlorides is considered to be from 10 to 15 grammes.

In many cases of interstitial nephritis, the urinary phosphates are scanty. The late Dr. Purdy held that diminution of the phosphates was as characteristic of this disease as albumin itself. This is scarcely a safe guide in diagnosis as, in some cases of interstitial nephritis, the phosphates are normal or even largely increased. Their normal elimination varies widely, calculated as phosphoric acid from 1 to 5 grammes with an average of 2.5 grammes.

Sulphates are of two kinds, the inorganic and the ethereal sulphates. The inorganic sulphates have no present interest. The ethereal sulphates are held by many to be an accurate index of the extent of intestinal decomposition. They have the same significance that has been attributed to indican. Calculated as sulphuric acid, the total elimination is about 2.5 grammes.

QUANTITATIVE ANALYSIS OF THE INORGANIC SALTS.

In estimating the quantities of the inorganic salts, the simple tests of dropping reagents into the urine and noting the density of the resulting presipitation, are worthless except, perhaps, in demonstrating the remarkable scarcity of chlorides in some cases of pneumonia. Except this, the only observation of these salts worth ascertaining is the total elimination in 24 hours. Even this figure is without meaning unless the quantity and kind of food taken and the disease suffered from are known.

The inorganic salts may be estimated accurately by titration, but, for the past fifteen years, the author has used with great satisfaction, the quantitative method of uranalysis by centrifuge, developed by C. W. Purdy. The centrifugal method gives quick and sufficently accurate quantitative estimation of chlorides, phosphates, sulphates and albumin.

QUANTITATIVE URANALYSIS BY CENTRIFUGE.

The author is indebted to the F. A. Davis Co., for their kindness in permitting him to copy the tests and tables from Dr. Purdy's "Practical Uranalysis," published by them. For further details of quantitative analysis by centrifuge and its application to specimens other than urine, the reader is referred to Dr. Purdy's book.

Objection has been made that the centrifugal methods are not as accurate as titration and that one has to stand over the machine with the speed-indicator to know whether the required speed is maintained. These objections are trivial. In dealing with substances of which the normal daily variation is wide, minute accuracy is not required. The machine designed by Dr. Purdy, operated by the current for which the motor is designed, when well oiled and loaded with two tubes, has a sufficiently constant speed of 1500 revolutions per minute, the speed used in the albumin test. Loaded with four tubes, the speed is about 1200 revolutions, the speed used for chlorides, phosphates and sulphates.

The centrifuge should have a radius of exactly 6¾ inches and must carry a load of two or four tubes of 15 c.c. capacity at a speed of 1200 to 1500 revolutions per minute.

The conical tubes should be graduated from 1 to 15 c.c. in tenths of 1 c.c., the lower c.c. being further graduated in quarter-tenths.

The author recommends the Purdy centrifuge, designed by Williams, Brown and Earle, of Philadelphia. One of these machines has been in daily use in his laboratory for fifteen years. During this time it has been abused and neglected by himself and by successive assistants but has required no repairs and is running to-day as well as ever.

The speed-indicator supplied with the centrifuge should be used at first to learn whether the machine revolves at the proper speed with the current used. From time to time the machine should be tested with the speed-indicator to make sure that the supposed speed is maintained.

As in all quantitative analysis of urine, the amount of urine passed in twenty-four hours must be known and the sample must be taken from the mixed urine.

For the estimation of albumin by centrifuge, see page 33.

QUANTITATIVE URANALYSIS BY CENTRIFUGE.

Chlorides, Phosphates and Sulphates.

Required: Purdy's centrifuge or its equivalent
4 conical centrifugal tubes of 15 c.c. capacity, Purdy's design, and corks (ordinary bottle corks).
For chlorides: Nitric acid and solution silver nitrate
For phosphates: Acetic acid and solution uranium nitrate
For sulphates: Mixture barium chloride and hydrochloric acid
For albumin, see page 32.

Test: Fill three of the tubes with urine to the 10 c.c. mark
To the first tube, add 1 c.c. strong nitric acid and 4 c.c. solution silver nitrate.
Cork and mix by inverting five times.
To the second tube, add 2 c.c. acetic acid and 3 c.c. solution uranium nitrate.
Cork and mix.
To the third tube, add 5 c.c. barium chloride mixture.
Cork and mix.
Remove the corks. Stand the tubes aside for 3 minutes to ensure complete precipitation.
Place tubes in centrifuge, balancing by the fourth tube filled with water.
Revolve at 1200 revolutions per minute for exactly 3 minutes.

Interpretation: The chlorides are precipitated as silver chloride; the phosphates as uranium phosphate and the sulphates as barium sulphate.

When precipitated in this manner, their bulk corresponds respectively to the quantities of the urinary salts given in the tables on next page.

Formulæ.

For Chlorides.

Silver nitrate c.p. .... 4 drams
Distilled water .... 4 ounces
Mix.

For Phosphates.

Uranium nitrate .... 4 scruples
Distilled water .... 4 ounces
Mix.

For Sulphates.

Barium chloride .... 1 ounce
Distilled water .... 4 ounces
Strong hydrochloric acid .... 2 drams
Mix.

Chlorides
In terms of Sodium Chloride

Bulk of AgCl.	Grains per oz. NaCl.
½	0.31
1	0.62
1½	0.93
2	1.24
2½	1.56
3	1.87
3½	2.18
4	2.49
4½	2.8
5	3.11
5½	3.42
6	3.73
6½	4.05
7	4.35
7½	4.67
8	4.98
8½	5.29
9	5.6
9½	5.91
10	6.22
10½	6.53
11	6.84
11½	7.2
12	7.46
12½	7.78
13	8.09
13½	8.4
14	8.71
14½	9.02
15	9.33

Phosphates
In terms of Phosphoric acid

Bulk of H(UO2) PO4	Grains per oz. P2O5
½	0.1
1	0.19
1½	0.22
2	0.24
2½	0.26
3	0.29
3½	0.31
4	0.34
4½	0.36
5	0.38
6	0.43
7	0.48
8	0.53
9	0.58
10	0.62
11	0.67
12	0.72
13	0.77
14	0.82
15	0.86
16	0.91
17	0.96
18	1.
19	1.06
20	1.1

Sulphates
In terms of Sulphuric acid

Bulk of BaSO4	Grains per oz. SO3
⅛	0.19
¼	0.34
⅜	0.48
½	0.62
⅝	0.77
¾	0.91
⅞	1.06
1	1.1
1¾	1.49
1½	1.78
1¾	2.06
2	2.35
2¼	2.64
2½	2.93
2¾	3.22
3	3.5
3¼	3.79
3½	4.08
3¾	4.37
4	4.66
4½	4.94
4½	5.23
4¾	5.52
5	5.81

GASTRIC CONTENTS.

A normal stomach performs two functions. It secretes juice of certain composition, the secretory function; and empties its contents into the duodenum within a definite time, the motor function.

The Secretory Function: It should be remembered that the normal stomach contains gastric ferments and hydrochloric acid only after stimulation by food. Accurate conclusions cannot be drawn from the examination of gastric contents unless it is known how long after eating and after what kind of food the specimen was vomited or removed.

THE TEST BREAKFAST.

Two slices of bread and one glass of water, taken if possible at the usual breakfast time. Remove with stomach tube exactly 60 minutes from the time of beginning the meal. Be sure the patient takes nothing else that morning, especially no milk or butter, which might vitiate the test for lactic acid.

The Motor Function: In gastric neurasthenia or disorder of its nervous mechanism, the stomach may empty itself into the duodenum too rapidly, in which case, the stomach is found empty when examined one hour after a test breakfast. The breakfast should then be repeated several times, withdrawing at intervals of one-half hour or less after the meal.

A more serious and more common defect of the motor function is retention of food in the stomach for an abnormally long time. This is an important sign in the diagnosis of carcinoma of the pylorus or ulcer near the pylorus or in the duodenum. The retention is due to narrowing of the pylorus, either the organic stricture of carcinoma or a cicatrized ulcer or the spasmodic contraction of the pylorus associated with an open, irritable ulcer. Retention is less common as a result of prolapse of the stomach with kinking of the pyloric region.

Retention of food an abnormally long time is most conveniently tested by having the patient eat partially cooked rice with raisins on the evening before the test breakfast is taken. The appearance of the rice or raisins in the test breakfast removed next morning indicates abnormal retention.

Some prefer to wash out the stomach in the evening shortly before giving the rice and raisins and to wash out the stomach again in the morning. If the motor function is normal, these foods will have disappeared.

THE STOMACH TUBE.

Select a tube that is sufficiently rigid not to double up in the pharynx. The safest is the Leube tube with two fenestra, one on each side of the tip but the end of the tip should be rounded and closed. A fenestrum on the tip may injure the gastric mucous membrane.

Select a large size, No. 35 French, for general work, for patients with tolerant throats and those accustomed to gastric lavage. A tube of large diameter is less apt to be obstructed by masses of food or mucus or to be closed by the spasmodic clutch of the muscles of the pharynx.

Select also a tube of small diameter, No. 29 French. Patients who choke or reject No. 35 often tolerate No. 29 easily. No. 29 is suitable also for children.

The tube should be marked at a point 22 inches from the tip, this being the usual distance between the front teeth and the lower border of the stomach.

PASSING THE TUBE.

The stomach tube should not be passed on a patient who is very feeble or one with aortic aneurism, with advanced valvular disease of the heart, with tuberculosis of the lungs or one who has recently had gastric hæmorrhage. The absence of these conditions should be ascertained. The tube should be passed with great caution if at all in gastric ulcer or carcinoma on account of the danger of exciting hæmorrhage.

The patient sits in a chair, preferably facing a wash basin, the clothing protected with a towel or bib.

Tight clothing about the patient's neck is loosened.

Never neglect to ask the patient to remove false teeth or plates from the mouth.

In removing a test meal, have ready to receive the gastric contents a clean, wide-mouth, four-ounce bottle or a clean bowl and a glass funnel to attach to the tube if neceassry.

Have ready also a two-quart pitcher of warm water for lavage or to pour down the tube to remove obstruction in case the test meal is not ejected.

Lubricate the tube by dipping it into the water.

Tell the patient that you will place the tube on the back of the tongue, that he should make one strong swallow and then remain passive, drawing deep breaths in and out. Immediately after the patient has swallowed, press the tube gently onward down the œsophagus. There is usually some resistance at the entrance to the œsophagus behind the larynx and again when the tube enters the stomach. When the mark on the tube is at the front teeth, the tip of the tube is in the stomach. Hold the outer end of the tube as low as possible to get siphonage.

When the tube enters the stomach there is usually an outrush of gas. Then the gastric contents flows steadily or intermittently. If no gastric contents appears, ask the patient to take a long breath, hold it and squeeze the abdomen as if defecating. Move the tube in and out to tap different levels of the stomach. If no contents is obtained, attach the glass funnel and pour a little water down the tube to dislodge any mass of food that may obstruct the fenestra. It is better to obtain a test meal undiluted with water, as such rough dilution makes the resulting figures of acidity uncertain.

If no gastric contents is obtained in this way, pour a pint of water into the stomach and siphon it out. If the water returns clear, it may be concluded that the stomach is empty.

Guard against over-distending the stomach by noting the amount of water poured in and the amount removed.

If there is difficulty in swallowing the tube, try again with a tube of smaller diameter. The chief difficulty is to get the tube past the constrictors of the pharynx just behind the larynx. A whalebone stylet is useful to carry the tube past this point. Then the stylet is withdrawn and the tube passed on down the œsophogus. Or have the patient return the next day after another meal. Usually the second trial will succeed. If necessary to carry the test through, swab the posterior wall of the pharynx with a 5% watery solution of beta-eucaine every minute for five minutes, wait a few minutes more and introduce the tube. Cocain is more effective but should be avoided as some patients are sensitive to it and collapse under its use.

FREE HYDROCHLORIC ACID.

Modified Gunzberg.

Required: Vanillin
Phloroglucin
Small white butter plate or any small white dish.
Bunsen flame or alcohol lamp.

Test: Wash the dish to remove all traces of acid. Dry it.

Make a fresh solution by mixing on the dish a few granules of vanillin, twice as much phloroglucin and a few drops of alcohol.

Add a few drops of gastric contents, preferably the filtrate.

Mix by tilting the dish.

Pour off the excess so that only a moisture remains in the dish.

Warm the dish gently over the flame.

Interpretation: As the film dries, the appearance of a cherry red color indicates the presence of free mineral acid. In the case of gastric contents, we assume this to be hydrochloric acid.

If there is no free hydrochloric acid, the film turns yellow but never red.

This modification of the Gunzberg test is preferable to the stock alcoholic solution of vanillin and phloroglucin because the stock solution may fail to react if not fresh. In the modified method, the fresh solution and the test are made at the same time. The alcohol may be dispensed with, in which case the vanillin and phloroglucin are mixed directly with the gastric juice.

QUANTITATIVE ESTIMATION OF FREE HYDROCHLORIC ACID.

Required: Decinormal solution sodium hydrate
Alcoholic solution dimethylamidoazobenzol, ½%
Alcoholic solution phenolphthalein, 1%
50 c.c. burette graduated in 0.1 c.c.
Beaker, 5 c.c. capacity.

Test: Fill the burette above 0 with decinormal sodium hydrate solution
Let the solution run out to 0. This eliminates the air from above and below the cock.

To 10 c.c. mixed gastric contents in the beaker, add two drops dimethylamidoazobenzol. An immediate cherry red color indicates free mineral acid, in this case, assumed to be hydrochloric acid. If no red color appears, there is no free HCl.

If the cherry red of free HCl appears, mix by gently swirling the fluid in the beaker. Avoid stirring-rod; it breaks beakers and is one thing more to clean.

Add the decinormal sodium hydrate solution drop by drop, mixing constantly until the red color changes to yellow, *and does not return on mixing.* This color change indicates that all the free acid has been neutralized. Save the mixture for the test for total acidity.

Interpretation: The number of c.c. decinormal sodium hydrate solution that neutralizes the free acidity of 100 c.c. of juice is required. As only 10 c.c. have been used in the test, the number of c.c. multiplied by ten gives the figure of free acidity desired.

Example: If 1.5 c.c. have been used, 1.5 c.c. x 10 = 15; free acidity of 15
If 2.8 c.c. have been used, 2.8 c.c. x 10 = 28; free acidity of 28.

TOTAL ACIDITY.

To the same 10 c.c. of juice that has been used in the estimation of free HCl, add two drops of phenolphthalein solution and continue to add the decinormal sodium hydrate from the burette, mixing constantly until the fluid turns pink.

The number of c.c. of sodium hydrate solution, calculating from 0 on the burette, required to bring the pink color in 100 c.c. is the figure of total acidity desired. As 10 c.c. have been used in the test, multiply the c.c. used by 10.

Example: If 3.2 c.c. have been used, 3.2 c.c. x 10 = 32; total acidity of 32.
If 6.4 c.c. have been used, 6.4 c.c. x 10 = 64; total acidity of 64.

FORMULA.

Decinormal solution sodium hydrate. To make 4 ounces

Normal solution sodium hydrate	12 c.c.
Distilled water	108 c.c.

Mix. Filter.

Normal solution sodium hydrate. To make 4 ounces.

Sodium hydroxid	4.92 grammes
Distilled water	120 c.c.

Mix. Filter.

Dimethylamidoazobenzol	2½ grains
Alcohol	1 ounce

Mix. Filter into 1 ounce dropping bottle.

Phenolphthalein	5 grains
Alcohol	1 ounce

Mix. Filter into 1 ounce dropping bottle.

LACTIC ACID.

Required: Strauss separating funnel
Ether.
Solution ferric chloride, 10%
Water.

Test: Into the funnel, pour filtered gastric juice to the mark 5 c.c. and pure ether to the mark 25 c.c. Shake vigorously.
Let stand a few moments for the ether and gastric contents to separate.
Open the cock and drain off the 5 c.c. of gastric contents.
Add water to the mark 25.
Add one drop ferric chloride solution; shake.
Let stand to separate.

Interpretation: Lactic acid fn the gastric contents is extracted by the ether and passes from the ether into the water. On separating, the *ether* will be colorless. If lactic acid is present, the *water* will have a greenish tint, the depth of color showing the quantity present. In case of doubt, with pale color, it is well to add a drop of ferric chloride to the same quantity of water in a test tube and examine the two mixtures side by side against a white background.

Solution ferric chloride, 10%.

Ferric chloride...................... 1 dram
Distilled water...................... 1 ounce
Mix. Filter into 1 ounce dropping bottle.

BLOOD.

Required: Powdered guaiac
Alcohol
Hydrogen dioxide
1 test tube

Test: Make a fresh tincture of guaiac by shaking a pinch of the powder in half-an-inch of alcohol in a test tube.

Add half-an-inch of gastric contents and half-an-inch of hydrogen dioxide. Shake well.

Interpretation: A blue color appearing on the addition of the dioxide indicates blood. On standing, the color becomes deeper.

BILE.

Bile can often be recognized by its yellow or green color but errors are made by confusing with green mucus or yellow or green foods.

Test a filter paper through which the gastric contents has been filtered by applying a drop of nitroso-nitric acid as described on page 45 or overlie the acid or iodin solution with gastric filtrate, as with urine.

In testing starch digestion, when the iodin and the filtered gastric juice flow together on a white dish, a dark green color at the line of contact indicates bile pigment.

FERMENTS.

Tests for ferments are useful chiefly to identify a given specimen as really gastric juice, differentiating from mucus or contents of a diverticulum. Tests for activity of ferments are not yet of practical value in diagnosis. If free hydrochloric acid is present, it may be assumed that the ferments are present and active.

PEPSIN.

Required: Discs of coagulated egg albumen
Test tube
Incubator or equivalent warm corner.

Test: Wash the disc of egg albumen in water.
Filter 10 c.c. gastric juice into a test tube.
Add one disc egg albumen.
Place in incubator at 37 degrees C. for one hour.

Interpretation: At the end of one hour, the disc should have been dissolved. This test is very variable in its results depending on how long the egg has been boiled. The egg should be boiled very lightly, just enough to coagulate the albumen.

Egg Albumen Discs.

Preserved for use.

Boil one egg just long enough to coagulate the albumen. From the softer part cut discs 10 millimeters in diameter and 1.5 millimeters thick. Keep in glycerin in wide mouth bottle.

CHYMOSIN.

To a test tube half full of milk, add two drops of gastric juice. Set aside in incubator or in a glass of warm water. Within five minutes, the milk will coagulate, indicating the activity of chymosin.

Hydrochloric acid alone will coagulate milk but not in the dilution used in this test.

The test should not be warmed much above blood-heat or the chymosin will be destroyed.

A more delicate test is to neutralize 10 c.c. gastric juice with decinormal sodium hydrate solution and phenolphthalein, add 10 c.c. milk and set aside in incubator or warm water. Coagulation occurs in 15 minutes.

STARCH DIGESTION.

USED ONLY AFTER A TEST MEAL CONTAINING STARCH.

Required: Gram's solution of iodin (or a weak watery dilution of tincture of iodin, one drop to half a test tubeful of water)
A white dish (butter dish)

Test: On the white dish, let a few drops of the iodin solution flow into an equal quantity of the *filtered* gastric juice.

Interpretation: If starch digestion has proceeded normally, there will appear at once a violet or mahogany brown, due to the reaction of iodin with erythrodextrin.

The ptyalin of the saliva continues its starch converting action in the stomach until the acidity of the gastric juice rises to a certain point.

The starch is converted first into soluble starch, which turns blue with iodin.

It is next converted into erythrodextrin, which turns violet or mahogany brown with iodin, and next into achroodextrin, which remains colorless with iodin.

In a test meal, we usually find much of the starch in the stage of erythrodextrin.

Theoretically, an excessive or early acidity of the gastric juice checks the starch digestion in the soluble starch stage, *the filtrate* turning blue with iodin, while deficiency of HCl permits much of the starch digestion to proceed to achroodextrin, the filtrate remaining unchanged with iodin or only assuming the reaction of erythrodextrin slowly. Practically, these variations are rarely met. Virtually all test meals containing starch give a prompt violet or mahogany reaction between the filtrate and iodin.

MICROSCOPIC EXAMINATION OF GASTRIC CONTENTS.

Microscopic examination of gastric contents yields surprisingly little information and is practically limited to search for Boas-Oppler bacilli. *Boas-Oppler bacilli* are large coarse bacilli arranged in chains, found in immense numbers in the mucus of many cases of cancer of the stomach. They are by no means pathognomonic of cancer of the stomach but suggestive or confirmatory if accompanied by other signs of this disease. They are allied to lactic acid bacilli but their cultural peculiarities have not been worked out.

The *Sarcina Ventriculi* was formerly regarded as diagnostic of chronic catarrhal gastritis. In recent years it has lost significance, being replaced by the more exact chemical studies of the gastric contents.

The examiner should be cautious in recognizing *red blood corpuscles* in the gastric contents. The stomach harbors many specimens of fungus with spores that simulate red blood corpuscles, both in the form of yellowish disks and colorless double rings exactly like red corpuscle "ghosts." Such an appearance of blood should be verified by chemical examination. Microscopic amounts of blood may easily be due to the irritation of the stomach tube and have no significance on diagnosis.

Gram's Solution of Iodin.

Iodin crystals	0.4 gramme
Potassium iodid	0.8 gramme
Water	120 c.c.

THE BLOOD.

Blood is Examined to Recognize the Following Conditions:

The anæmias
Leucocytosis and the *leukæmias*
Parasites; in the temperate zone, chiefly the malarial parasites.
Typhoid fever, by the Widal test and blood culture.
Syphilis, by the Wassermann test.
Septicopyamia, by blood culture.
(Tuberculosis and cancer cannot be diagnosed by examining the blood).
Diagnosis of these diseases requires the following data:

The anæmias:

The percentage of hæmoglobin.
The number of red cells in one cubic millimeter of blood; called the "red cell count."
The shape, size and depth of color of the red cells, studied in the smear.

Leucocytosis and the leukæmias:

The number of leucocytes in 1 cubic millimeter of blood; called "the leucocyte count."
The relative proportion of the different kinds of leucocytes; called "the relative count," studied in the smear.

It is a common error to send to the laboratory for examination a drop of blood dried on a slide. Such specimens permit of very imperfect conclusions. To yield information, the specimen of blood must be taken from the patient in a certain way and with certain apparatus to be described.

Of these examinations, hæmoglobin, the count of red cells, the count of leucocytes and the blood culture require that the one who takes the specimen possess the requisite apparatus and a certain technical skill, which however, is acquired with very little practice.

Study of the shape, size and color of the red cells, the relative count of leucocytes and the search for parasites requires that a thin film of fresh blood be spread upon a glass slide and dried in the air. This is called a smear. A smear is always stained for examination. See page 81.

For details of typhoid diagnosis and blood culture, see page 86.

For Wassermann, see page 92.

With a little practice, all of these examinations except the blood culture and the Wassermann can be carried out in the office of any physician possessing a microscope and an immersion lens. Except the microscope, the apparatus is not expensive.

APPARATUS FOR BLOOD EXAMINATION.

Hæmoglobin scale or hæmoglobinometer
Diluting pipette and fluid for red cell count
Diluting pipette and fluid for leucocyte count
Rubber suction ball
Glass slides for smears
Stain for smear. See page 81.
Stain for malarial parasites—Giemsa
Microscope with oil immersion lens.

For Blood Culture and Wasserman.

Hypodermic syringe of 10 c.c. capacity
Tubes of sterile bouillon, for culture
Sterile bottle and cork for Wassermann.

The Rubber Suction Ball.

The rubber suction-ball is the author's contribution to practical hæmatology. It replaces the mouth suction-tube in obtaining the specimen. It is an ordinary soft rubber infants' rectal syringe. The suction-ball is awkward at first but, with a little practice, the examiner becomes skilful in its manipulation. The consciousness of cleanliness and safety will repay the examiner for the little patience required to master the manipulation of the suction-ball. In handling infectious disease, it is safer to keep both specimen and finger out of the mouth.

OBTAINING THE SPECIMEN.

Wash the hands of the operator and the lobe of the patient's ear with ether or alcohol and puncture with a glass point.

The Location; the best location is the lobe of the ear. The skin here is thin and not sensitive while the skin of the finger, which is often used, is thick and sensitive. An especial advantage with children and sensitive adults is that the ear is out of sight. With a sharp glass point, the patient, whether adult or child, seldom feels the puncture or realizes what is being done. The lobe of the ear is more easily kept clean than the fingers which are constantly soiled.

The Puncture: The puncture is best made with a glass point, as suggested by Wright. In a Bunsen flame, draw one-eighth inch glass tubing to a fine point and break off the excess point. Puncture with such a point is deep, yields a large drop of blood and is practically painless, an important matter with children when you expect to take a second specimen. Of course, care should be taken not to use a point so delicate that it will break off in the skin.

The puncture may be made with any needle. A sewing needle is seldom sharp enough to do the work neatly. Special blood lancets are unnecessary. They are difficult to clean and always dull.

The Antiseptic: Any surgical method of cleaning the skin is appropriate. Long experience and many punctures in all parts of the body have given the author confidence in alcohol or ether as sufficient for skin disinfection.

THE PERCENTAGE OF HAEMOGLOBIN.

A hæmoglobinometer is an instrument or scale presenting different tints with which the specimen of blood is compared. The color of normal blood is arbitrarily called 100%.

In the Fleischl instrument, the scale is a wedge of colored glass of diminishing thickness.

In Gowers', it is a tube of glycerin colored with eosin.

In Dare's, discs of colored glass of different thickness.

In Tallquist's, the color scale is printed on paper.

The Fleischl and the Dare are expensive, troublesome to keep clean and unnecessarily complex

The Gowers is cheaper and simpler.

The Tallquist scale is the least expensive. It is sufficiently accurate and by far the most convenient. The color scale is bound in a little book of absorbing paper.

TECHNIQUE.

On a leaf of the paper, absorb a large drop of blood.

Fold the paper so that the stain has a white background.

Compare the red stain with the color scale *at once* or as soon as the wet gloss is gone, by daylight. As the drop dries, the color dries lighter and is then inaccurate.

THE RED CELL COUNT.

Required: Diluting pipette for red cells
Diluting fluid for red cells
Rubber suction ball
Counting chamber and thick cover glass.

Technique Attach rubber ball to pipette. Expel the air.
Draw up a fresh drop of blood to the mark 1.
Holding the tube upright so that the air leaves the glass bulb first, draw up diluting fluid to the mark 101.
Detach the rubber suction ball, close the upper end of the diluting tube with one finger and shake vigorously for two minutes.

(At this point, the tube may be laid aside for future examination. While at rest, the red cells will settle to the bottom of the glass bulb. When the examination is resumed, the diluting tube must be shaken vigorously for at least two minutes to make an even mixture. The specimen should not be laid aside more than a few hours because, unless the diluting fluid is exactly the right strength, the red cells slowly dissolve).

After shaking thoroughly, attach the rubber suction ball and expel the diluting fluid from the lower part of the tube.
Expel a small drop of the diluted blood on the glass table of the counting chamber.
Apply the thick, planed cover-glass and set aside for a few minutes.
The red cells will settle in one plane and are thus more easily counted.

It is not desirable to permit the blood to flow beyond the glass table into the moat that surrounds it. The cover-glass should be pressed down *at the edge,* not in the centre.

COUNTING THE RED CELLS.

The square millimeter in the counting chamber is ruled into 400 small squares and further divided into groups of 16. A beginner should count the red cells in each square up to 80 squares.

The experienced observer learns to count the red cells in 16 small squares with a lens of lower power, writing down the number of cells in 16 squares at once.

At least 80 small squares should be counted, or six groups of 16. Cells lying on the lines are apt to be counted twice. To prevent this, count the cells on the upper and left border of a square and disregard those on the lower and right border.

To find the average number of cells in a small square, divide the total number of cells counted by the total number of small squares counted. Suppose there were 826 cells in 96 squares. $826 \div 96 = 8.6$ the average number of cells per square.

As there are 400 small squares, multiply the average number of cells per square by 400 to obtain the cells in the square millimeter.

$$8.6 \times 400 = 3440.$$

As the counting chamber is only 0.1 millimeter high, multiply by 10 to obtain the full cubic millimeter.

$$3440 \times 10 = 34,400.$$

As the blood was originally diluted 1 to 100, multiply by 100 to restore it to its original volume.

34,4400 x 100=3,440,000 red cells in one cubic millimeter of blood.

DILUTING FLUID FOR RED CELLS.

An Emergency Mixture.

Saturated solution sodium chloride	5 drops
Water	½ ounce

Mix.

The sodium chloride solution should be made fresh every few days, to guard against the growth of fungus, the spores of which may be confused with blood corpuscles.

Hayem's solution is preferable because permanent, the mercuric chloride preventing the growth of fungus.

Hayem's Solution.

Mercuric chloride	1 grain
Sodium sulphate	12 grains
Sodium chloride	2.5 grains
Distilled water	1 ounce

Mix.

Colored fluids, as Toison's, are unnecessary. In the interest of cleanliness of hands and apparatus, unnecessary staining fluids should be avoided.

THE LEUCOCYTE COUNT.

Required: Diluting pipette for leucocytes
Diluting fluid for leucocytes
Rubber suction ball
Counting chamber and thick cover glass

Technique: Attach rubber ball to pipette and expel the air.

Draw up a fresh drop of blood to the mark 1.

Draw up diluting fluid to mark 11, holding pipette upright to withdraw the air first.

Detach the rubber suction ball, close the upper end of the pipette with the finger and shake vigorously.

(At this point, the tube may be laid aside for future examination. While at rest, the leucocytes will settle to the bottom of the glass bulb. When the examination is resumed, the diluting tube must be shaken vigorously for at least two minutes to make an even mixture).

After shaking thoroughly, attach the rubber suction ball and expel the diluting fluid from the lower part of the tube.
Expel a small drop of the diluted blood on the glass table of the counting chamber.
Apply the thick, planed cover-glass and set aside for a few minutes.
The leucocytes will settle in one plane and are thus more easily counted.

COUNTING THE LEUCOCYTES.

In counting leucocytes, the small squares are disregarded. Count the number of leucocytes in the entire square millimeter.

A beginner should count the leucocytes slowly with the high power lens and a mechanical stage.

The experienced observer will learn to count more quickly with a lower power lens and the diaphragm closed. There are strips of small squares, four wide, across the ruled square, divided by a single line of bisected squares. Count from left to right on the broad strip and back on the single line.

The number of leucocytes counted is the number contained in one-tenth of a cubic millimeter, the chamber being one-tenth of a millimeter deep. Multiply by 10 to obtain the full cubic millimeter.

Suppose 75 leucocytes have been counted on the square millimeter,

$$75 \times 10 = 750.$$

As the blood was originally diluted 1 to 10, multiply by 10 to restore it to its original concentration.

$750 \times 10 = 7500$ leucocytes in one cubic millimeter of blood.

Experienced workers usually draw the blood drop into the pipette only to the mark 0.5 and finally multiplied by 20 instead of 10. The greater dilution gives more uniform results, especially in leucocytosis.

Diluting Fluid for Leucocytes.

Acetic acid	2 drops
Water	½ ounce

Mix.

THE BLOOD SMEAR.

All smears are stained for examination.

The smear must be evenly spread, firmly fixed and properly stained.

Required: 2 clean glass slides.
Fixing and staining fluid (Jenner, Leishman, Wright, Hastings, Giemsa).

SPREADING.

Receive a fresh drop of blood on a glass slide near one end. Spread by pushing the drop of blood with the end of another slide. If the end of the "pusher" is notched with a file, it makes a better smear. Spread two slides. If one is spoiled in staining, the other is available.

Let the smears dry separately in the air. Never let them stick together.

For Widal typhoid agglutination test, place three large thick drops on one slide. Dry in air without spreading. See further page 88.

For special technique with malarial parasites, see page 84.

FIXING THE BLOOD SMEAR.

As in all tissue staining, it is necessary to "fix" the smear, that is, to coagulate the albumin of the corpuscles. This "fixes" the hæmoglobin in the red cells so that the staining manipulations do not wash it out. brings out the details of the leucocytes; and fastens the smear to the glass so that it does not easily wash off in staining. Specimens that are not "fixed" stain poorly.

Blood smears were formerly fixed by heat on copper plates or in blood-ovens. The introduction of the alcoholic stain made the blood-oven obsolete. The alcoholic stain fixes and stains the smear at the same time.

Of the popular blood stains, Jenner, Leishman, Wright, Hastings and Goldhorn are alcoholic. Giemsa is used in watery solution. Therefore, only Giemsa requires fixing before staining. See page 82.

STAINING THE BLOOD SMEAR.

In this country, the original Ehrlich tri-acid stain and the triple stain are obsolete. The most easily prepared and satisfactory stain for differential blood count is Jenner, a mixture of methylene blue and water soluble eosin in absolute methyl alcohol.

Other modern blood stains are modifications of Romanowsky. Romanowsky first employed for staining malarial parasites the compound formed when a watery solution of methylene blue and water soluble eosin are brought together. Leishman combined this preparation with the convenient Jenner methyl alcohol method. Wright and Hastings are variants of Leishman.

Leishman, Wright and Hastings all stain malarial parasites and give differential stain of the blood corpuscles; but the blood differentiation is not as clear as Jenner.

Use Jenner as a routine stain for differential count.

Use Giemsa or one of the others for malarial parasites.

All these staining fluids are cheap and may be purchased from any supply house. In preparing them, Grubler's dyes are universally used.

JENNER STAIN.

Flood the smear with Jenner stain.
Let stand two minutes.
Wash in water till film is pink.
Stand in clean water 2 minutes.
Dry in air.
Place drop of immersion oil directly on the smear and examine with immersion lens.
Or, after drying in air, apply Canada balsam and thin cover-glass.

GIEMSA STAIN.

This stain is used in watery solution and requires preliminary "fixing" with alcohol.
Flood slide with or immerse slide in absolute alcohol 20 minutes.
Dry in air.
On the slide, place 15 drops warm water; add 1 drop Giemsa stain and mix.
Let stand to stain 15 minutes.
Wash in water.
Dry in air.
Place drop of immersion oil directly on smear and examine with oil immersion lens.
Or, after drying in air, apply Canada balsam and thin cover-glass.

LEISHMAN'S BLOOD STAIN.

Dry smear in air.
Flood smear with Leishman's stain.
Let stand 1 minute.
Add water drop by drop until a greenish iridescence appears on the surface, about double the quantity of the stain.
Let stand 5 minutes.
Wash in water.
Let stand 2 minutes in clean water.
Dry in air.

WRIGHT'S BLOOD STAIN.

The film must be fresh, only a few hours old.
With a medicine dropper, cover film with stain. This fixes the blood.
After 1 minute, add an equal number of drops of water.
Stain 2 minutes.
Wash in water ½ minute or until thinner parts of film become pink or yellowish.
Dry in air.
Place drop of immersion oil directly on film or mount in Canada balsam and thin cover-glass.

HASTINGS' BLOOD STAIN.

Technique same as Leishman.

THE MALARIAL PARASITE.

The parasites are in the blood at all times but are more numerous a few hours before or after the chill.

For the living parasite, examine blood taken directly from the patient. Make a moist cell by streaking vaseline around the edge of a cover-glass. Touch a fresh drop of blood with the center of the cover-glass and drop it on a slide, vaseline side down. Examine with oil immersion. The parasites remain alive several hours and the specimen keeps several days.

Staining the Parasite.

The parasites are found more easily and their structure better demonstrated by making a smear in the usual manner and staining by Giemsa, page 82; Leishman, Wright or Hastings, page 83; Goldhorn, page 94; or by simply pouring over the dry film absolute methyl alcohol that is saturated with methylene blue. Let stand 10 seconds and wash in water.

In Ross' method, a large thick drop of blood is dried on a slide without heat. The hæmoglobin is dissolved out by flooding the slide with water and let stand 10 minutes. Then wash the slide very gently, not to wash off the film that has been softened by soaking in the water. Stain in the usual manner.

Ruge fixes the film and dissolves out the hæmoglobin at the same time by flooding the dried drop with water containing 5% formalin and 1% acetic acid. Stain as usual or with Manson's borax blue, page 104. Stain 30 seconds and wash in water.

RELAPSING FEVER.

The Spirochæta Obermeieri is a minute spiral with brisk movement found in the blood of relapsing fever. It is regarded as the microbic cause.

It appears in the blood shortly before the onset of the fever, increases until the beginning of the fever, disappears with crisis and remains absent during the interval.

Examine fresh blood or stain with Giemsa or Goldhorn, page 94 or the Leishman type of stains on page 83.

FILIARIAE.

In the blood of tropical chyluria and elephantiasis, the embryo filiariæ appear in the peripheral blood during the night and disappear during the day.

Take the specimen during the early part of the night. Examine the blood fresh or stain films with Giemsa or Goldhorn, page 94, or the Leishman type of stains on page 83.

TYPHOID DIAGNOSIS.

Typical cases of typhoid fever are easily diagnosed. There is the stepladder rise of temperature. At the end of the first week, there are the enlarged spleen, the crops of rose spots on the abdomen and the diarrhœa; in the second week, tympanites and perhaps intestinal hæmorrhage.

Atypical cases are difficult to distinguish from general sepsis, pyæmia and tuberculosis because all these symptoms except fever may be absent. It is in these cases that laboratory diagnosis is of great value; but laboratory diagnosis is not infallible. Some cases, both typical and atypical, run their entire course with negative laboratory tests.

Early tests: *Blood-culture* and *diazo.*

Late tests: *Widal, leucopenia, culture from feces and urine.*

LEUCOPENIA.

Uncomplicated typhoid fever differs from many other types of infection in its low leucocyte count, a neutrophile leucopenia. After an initial increase of neutrophiles, they decrease steadily in number until defervescence.

With complications, as pneumonia, suppurative lesions, meningitis, peritonitis or perforation, the usual leucocytosis of those disorders appears.

BLOOD CULTURE.

Blood culture is the earliest means of recognizing typhoid fever. The bacilli are found in the blood in the first week. They are most abundant during the first week and gradually decrease toward the end of the disease. In this respect, blood culture differs from the Widal reaction which seldom appears before the second week, but increases in intensity until deferescence.

Typhoid bacilli may be cultivated from the blood simply by allowing ten drops of blood to flow into a tube of bouillon but the culture is much more apt to be successful if 3 c.c. of blood are added to 20 c.c. of Conradi's ox-bile medium. With the technique described on page 92, draw 10 c.c. of blood from the distended vein with an all-glass syringe and inoculate three flasks, each with 3 c.c. of blood.

Theoretically, blood removed from the spleen by splenic puncture, page 120, would be the most likely to contain the bacilli. Practically, only a few drops of blood can be obtained from the spleen. Unless these few drops happen to contain the bacilli, the culture fails.

TYPHOID BACILLI IN THE URINE AND FECES.

In typhoid fever, the bacilli are found in the urine but their recognition is not of much use in diagnosis for they are found in less than half the cases and do not appear before the third week.

The bacilli may appear abundantly in the stools but usually not before the end of the second week. They can never be distinguished from other intestinal bacteria by simple microscopic examination. They must be isolated and identified by culture on various media, requiring considerable time, care and bacteriological skill. As most of the bacilli die soon after leaving the body, the culture must be made from the fresh stool.

WIDAL REACTION (WIDAL-GRUBER REACTION).

A loss of motility and clumping (agglutination) of typhoid bacilli when brought in contact with the blood-serum of a patient who has had typhoid fever. It is a late reaction, not appearing until the second week, increasing in intensity until deferescence. It then falls rapidly but may persist for many months or even years.

Taking the Specimen.

In public health work, a drop of blood dried on a slide is used because of its simplicity. In this case, a few loops of salt solution are added to the clot to restore it to its original volume. Experienced workers estimate the amount necessary by the color of the drop. This dilution is not as accurate as with pure serum.

It is better to draw ten drops of blood in a sterile glass tube or small bottle and send it to the laboratory. When the blood clots, the serum exudes and is available for the test. The ends of the tube should not be sealed in the flame except by experienced workers; for, heat destroys the agglutinins. Serum from a blister can be used as well.

Macroscopic Test and Killed Cultures.

The Widal reaction may be carried out in a small test tube as a macroscopic test or either microscopically or macroscopically with killed cultures. In doubtful cases, both methods are unsatisfactory.

Technique of Widal Reaction.

Required: 18 hour culture of typhoid bacilli in bouillon.
Blood-serum from clot or blister.
5 slides and cover-glasses. Hollow-ground slides are convenient but not necessary.
Distilled water or salt solution for dilution.
Vaseline or oil and a platinum loop.

Test: Mix a loop of the typhoid culture with a loop of water and examine for motility and clumping. If the bacilli are active and there are no clumps, the culture is suitable for the test. If clumps are present, filter through filter-paper.

On a slide, place one loop of blood-serum and 9 loops of water. Mix.

This gives a 1 to 10 dilution.

On a cover-glass, mix 1 loop of the 1 to 10 dilution with 1 loop of typhoid culture, giving a 1 to 20 dilution of the serum.

Apply vaseline to the edge of the cover-glass and mount as a hanging drop. If hollow-ground slides are not available, let one edge of the cover-glass rest on another cover-glass, making a wedge-shaped cell.

Examine with high-power dry lens for loss of motility and clumping, which may take place within a few minutes. If no reaction within five minutes, set aside.

On another cover-glass, mix 1 loop of the 1 to 10 dilution with 1 loop of water, giving a 1 to 20 dilution. 1 loop of this with 1 loop of typhoid culture gives a 1 to 40 dilution. Examine as before.

In the same way, make dilutions of 1 to 80 and 1 to 100.

Interpretation: Almost any pure blood-serum will agglutinate typhoid bacilli but this power is lost in dilutions of 1 to 5 and upward. The peculiarity of typhoid fever serum is that it retains its agglutinating power when highly diluted, 1 to 20, 1 to 40 and even much higher.

Clumping may take place with any serum after the preparation has stood for many hours. In the diagnosis of typhoid fever, it is generally agreed that clumping with a dilution of 1 to 40 within an hour is a positive reaction; otherwise it is negative.

Most chemical antiseptics even in a mere trace clump bacilli. Glassware used in this test should be washed in plain water and sterilized by heat.

EYE REACTION OF CHANTEMESSE.

Like the tuberculin eye reaction, 1-50 mg. of typhoid endotoxin dissolved in a few drops of water and dropped beneath the lower lid of a patient with typhoid fever, causes a reaction of congestion and lachrymation which reaches its maximum in from six to twelve hours and lasts from one to two days. It occurs early ln the disease but the technique has not yet been developed to a practical point. As conducted at present, it reacts in many diseases other than typhoid fever.

DIAZO-REACTION OF EHRLICH.

A color reaction in the suspected urine.

Required: Sulphanilic acid mixture.
½% sodium nitrite solution, made fresh every week.
Large test tube.

Test: To 10 c.c. sulphanilic acid solution in the test tube, add 3 drops sodium nitrite solution.
Add an equal quantity of urine and shake well till foam forms.
Add 20 drops ammonia and shake.

Interpretation: With urine of typhoid fever, measles and advanced tuberculosis, the urine turns ruby-red and the foam is pink. Many urines turn brown and the foam orange; but this is not a positive reaction.

The test may be modified by allowing the ammonia to overlie the mixture. A deep red band appears at the line of contact.

The urinary substance that gives the reaction is unknown. It occurs occasionally in so many infectoous fevers and other diseases that it is scarcely diagnostic of any. In typhoid fever it occurs early, from the middle of the first week onward but may appear for only a few days.

SULPHANILIC ACID SOLUTION

Sulphanilic acid	0.5 gramme
Hydrochloric acid	5. c.c.
Distilled water	100. c.c.

Mix.

SODIUM NITRITE SOLUTION.

Sodium nitrite	0.5 gramme
Distilled water	100. c.c.

Mix.

LABORATORY DIAGNOSIS OF SYPHILIS.

Typical cases of syphilis are easily recognized, but there are many atypical cases. Chancres and secondary symptoms are not always typical and may be unnoticed or misinterpreted. Tertiary lesions imitate many other diseases.

Laboratory diagnosis is based on finding:

the treponema pallidum
the Wassermann reaction
lymphocytosis in the cerebro-spinal fluid.

In primary syphilis, the earliest laboratory sign is the treponema pallidum, which is found in all chancres and in the neighboring lymphatic glands. The Wassermann reaction is found in less than half the cases of primary syphilis but appears with increasing frequency until the outbreak of the secondary symptoms, when it is found in practically all untreated cases and many that have been under treatment.

In secondary syphilis the treponemata are found quite easily in mucous patches, in condylomata and in enlarged lymphatic glands; with more difficulty in other lesions. The Wassermann is positive in all untreated cases.

In tertiary syphilis, ulcers and gummata, the treponemata are scanty and difficult to demonstrate. The Wassermann becomes the chief test, being positive in most untreated cases and in some cases under all treatments.

It is in tertiary and quaternary syphilis of the nervous system that lymphocytosis of the cerebro-spinal fluid comes to the front, being found in cerebral syphilis, syphilitic meningitis and in the later parasyphilitic diseases, tabes and general paralysis. This lymphocytosis is not a specific sign of syphilis for it occurs also in non-syphilitic, non-suppurative meningitis, in some cases of zoster, in multiple sclerosis and in tubercular meningitis. Its value is that, in a given case of syphilis, the lymphocytosis of the cerebro-spinal fluid is one of the earliest indications of invasion of the central nervous system and it differentiates these organic lesions from neuroses.

In the late parasyphilitic disorders, tabes and general paralysis, the treponema is not demonstrable; but the Wassermann reaction remains an important symptom throughout, being positive in most cases that have not recently been under anti-syphilitic treatment. In tabes, the cerebro-spinal fluid often gives the Wassermann reaction; in general paralysis, almost constantly.

In congenital syphilis, the treponemata are found in large numbers throughout the body. The Wassermann reaction may be negative at birth but is positive as soon as active syptoms appear.

TAKING THE SPECIMEN FOR THE WASSERMANN TEST.

The Wassermann test requires blood serum from the patient. Blood is allowed to clot in a sterile container; the serum exudes.

The Wassermann can never be an office test. Quite elaborate preparations are necessary; but when once ready, a large number of specimens can be tested at once. Most laboratories make the test only on certain days. It is desirable to separate the serum from the clot and to treat the serum carefully by heat as soon as possible. For this reason, it is well to send the patient directly to the laboratory examiner. If this is inconvenient, blood may be drawn from the patient into a sterile container, allowed to clot and sent at once to the laboratory. It should be kept from direct sunlight. After the serum has been properly heated, it will keep in good condition in the ice-box for several days.

The test requires not only much time to prepare but also much skill to conduct and a great deal of experience to interpret correctly.

It is often absent in syphilitics who have recently been under active treatment. There are many uncertain results. Only a positive reaction is significant and this is quite conclusive evidence of syphilis.

Required: Hypodermic needle, bore 16, preferably platinum-iridium, which is easily sterilized in the flame.
Sterile test tube or bottle, which must be dry, and sterile cork.
Alcohol lamp.
Rubber tube to constrict the arm.

Taking the specimen: Sterilize the skin of the anterior face of the elbow with alcohol. Constrict the arm above the elbow with the rubber tube.

Sterilize the needle in the flame and insert it into the most prominent vein, the point of the needle being directed toward the bandage, with the current.

Allow one inch of blood to flow into the tube or bottle.

Plug the tube with sterile cotton and apply cap or cork the bottle.

THE TREPONEMA (SPIROCHAETA) PALLIDUM.

The treponema pallidum or spirochaeta pallida is a delicate spiral, from 4 to 15 microns long, with from 4 to 20 sharp, deep turns. With it, there is often found the spirochaeta refringens, which is a longer, thicker, coarser spirillium with wide irregular turns. With Giemsa, S. refringens stains bluish violet while the pallida is usually pink (hence the name pallida).

Many other spirochætæ occur in the animal body, some normally in the mouth. The spirochæta dentium, particularly, resembles the spirochæta pallida but is smaller. Spirochætæ are also found in balanitis, ulcers, gangrene, the intestine of man and of the mosquito, the stomach of oysters and in the blood of relapsing fever, page 85.

Taking the Treponema.

Wash the lesion, chancre, mucous patch, eruption or condyloma, with sterile water and gauze.

Curette the base and margin of the lesion lightly till blood flows.

With sterile gauze, wipe away the blood till clear serum oozes.

A drop of the serum is used for examination, either fresh or stained or with the India ink method.

Lymphatic glands may be punctured and a few drops of serum extracted with a hypodermic syringe and a coarse needle, massaging the gland while the needle is in it, page 122.

The refraction of the treponema pallida is so low that it is difficult to see with the ordinary microscope. To study the parasite alive, mix a drop of serum on a cover-glass with a drop of distilled water, seal the cover-glass with vaseline and examine with a dark-ground condenser. This condenser is now made by all manufacturers to attach to their respective microscopes.

Stain by Giemsa.

Make a very thin smear of the serum.

Fix the smear in absolute alcohol, 10 minutes.

In a shallow dish, film side down, stain 2 to 24 hours in Giemsa, 10 drops of the stain and 1 drop of a 1% potassium carbonate solution to each 10 c.c. water.

Wash in water.

The treponema pallidum is usually pink but sometimes bluish. The other spirochætæ are bluish violet.

India Ink Method.

Use Higgins' American India Ink or the imported China Ink.

On a slide, mix a drop of serum with an equal drop India ink, and smear evenly. Let dry.

Place a drop of immersion oil directly on the dry film and examine with immersion lens.

The field is brownish-black. The treponema appears as a clear, white spiral.

Stain by Goldhorn.

Spread a drop of the serum on a slide in a thin layer. Do not fix.

On the unfixed smear, pour enough of the stain to cover.

Stain 4 seconds.

Dip the slide very slowly in clean water, holding the film side down.

Hold 4 seconds. Rinse for a moment with 5% alcohol to remove precipitate.

Wash in the water as usual; dry and examine with immersion lens.

The treponemata are violet.

Silver Nitrate Method.

The film is dried in an incubator for several hours.
Immerse in 10% silver nitrate solution for from 3 hours to 3 days in diffuse daylight.
The film turns brown and shows a metallic lustre.
Wash in water, dry and examine with oil immersion or mount.
The treponemata are black on a pale brown ground.

TREPONEMATA (SPIROCHAETAE) IN SPUTUM.

Spengler has recently announced that many cases of tubercular phthisis with abundant expectoration are really mixed infections of tubercle bacilli and the syphilitic treponema pallidum.

Bearing in mind that the several varieties of treponema or spirochæta which normally inhabit the mouth might easily extend to phthisical cavities, this statement should be received with caution. It requires confirmation. The sputum should be washed to eliminate the mouth bacteria.

Spengler's Technique

Shake a lump of sputum in Petri dish in sterile water with 1% formalin.
Wash in three successive dishes of the same solution.
Wash in 60% alcohol with 1% formalin in sterile watch glass.
Spread by pressure between two slides.
Dry one minute and stain with Giemsa as on page 94.
The syphilitic treponemata are red.

SMEARS AND THEIR STAINING.

Like blood-smears, smears of pus, sputum and mucus must be spread, fixed and stained.

Spreading.

To spread, press a small drop of the specimen between two glass slides and slip them apart, making a thin film on each side.

Dry them separately in the air. Two slides should never be permitted to stick together. Drying with gentle heat is permissible, holding them high over the flame or on a copper plate high over the flame.

When dry, the slides may be wrapped in paper for future study.

Fixing.

To prevent being washed off while staining, the smear must be fixed to the slide by alcohol or heat. After coagulation by heat or alcohol, the specimen takes the stain much better than when fresh.

Sputum, pus and all discharges are fixed by heat. Holding the slide in a metal clip or artist's wooden clip, film uppermost, pass it slowly over the Bunsen flame three times. Set aside to cool, except in staining tubercle bacilli, which are stained hot.

Blood is usually fixed and stained at the same time by an alcoholic staining fluid. See page 81.

Staining the Smear.

Except in tubercle bacillus staining, all stains are used cold.

After staining, the slide is washed in water and stood on end to dry. Drying may be hastened by laying the slide on a copper plate high over the flame. The heat should be gentle or it may spoil the specimen.

When dry, a drop of immersion oil is placed directly on the smear without interposing a cover-glass.

To make a permanent preparation, put a drop of Canada balsam instead of the immersion oil directly on the dry film and apply a thin cover-glass.

For routine work, three stains are required, carbol-fuchsin, Loeffler's methylene blue and methyl violet. The stain selected depends on the variety of bacterium supposed to be present. Most bacteria will stain with any one of them.

The methyl violet is used either alone or as the first step in Gram's stain. Gram is the most useful of all stains. It is a great help in diagnosis because of its selective action, staining some bacteria and decolorizing others.

Bacteria that stain with Gram are said to be Gram-positive.

Bacteria that are decolorized with Gram are said to be Gram-negative. For technique of Gram and list of positive and negative bacteria, see pages 102, 103, 105.

Staining the Smear.

Staphylococci and *Streptococci* are Gram positive and stain with all ordinary stains. Stain with Gram for differentiation.

The *Pneumococcus* is very inappropriately named for it is by no means the only organism that causes pneumonia nor is it confined to diseases of the respiratory tract. It is abundant in the sputum of some cases of pneumonia, both croupous and catarrhal, in bronchitis, in abscess of the lung, and in tubercular phthisis. It is an inhabitant of the normal mouth. It is the cause of virulent inflammation in all parts of the body, especially in infants. It may cause otitis media, meningitis, ulcerative endocarditis, pericarditis, pleurisy, empyema, peritonitis and septicæmia. By some, it is believed to be a variety of streptococcus and, in fact, is sometimes arranged in short chains.

The pneumococcus is lancet-shaped, arranged in pairs with the sharp ends pointing away from each other. It has a capsule which appears as a colorless zone around each pair of cocci. It is Gram positive and usually lies outside of the leucocytes. It stains with all dyes but its capsule is best demonstrated by flooding the film with acetic acid for a few seconds before staining. Without washing in water, flood several times with anilin-methyl-violet or carbol-fuchsin or stain with Gram. Wash with 2% NaCl solution instead of water.

When searching for the pneumococcus in sputum, to avoid contamination with mouth bacteria, have the patient rinse the mouth well, wash a lump of the sputum in water and make the smear from the center of the lump.

How inefficient a vaccine or serum made from the pneumococcus alone would be as a routine treatment for pneumonia is shown by the following list of the bacteria that are found as causes of pneumonia.

Pneumococcus	Pneumonia bacillus	Colon bacillus
Staphylococcus	Tubercle bacillus	Typhoid bacillus
Streptococcus	Influenza bacillus	Diphtheria bacillus
	Plague bacillus	

There are three diplococci, all Gram-negative and all intracellular, that are apt to be mistaken one for another; the *gonococcus*, the *meningococcus* and the *micrococcus catarrhalis*. The source of the specimen is some guide. Thus, intracellular, Gram-negative diplococci in pus from the urethra or cervix may be regarded as gonococci; from the spinal canal, as meningococci and from the respiratory tract, as micrococcus catarrhalis. This conclusion is not always safe; for, meningococci are found in nasal mucus and gonococci in meningeal exudate.

The *Gonococcus* is a large diplococcus, Gram-negative and contained within the pus cells, sometimes in large numbers. The slides should be smeared with pus taken directly from the patient. Stain with Loeffler and with Gram.

The *Meningococcus* or *Micrococcus Meningitidis Intracellularis* is a small diplococcus, Gram-negative and intracellular. It stains well with Loeffler. Differentiate with Gram.

Like pneumonia, meningitis may be caused by any one of many bacteria. Serum or vaccine treatment is useless unless the causative organism of that case is known. In a given case any one of the following may be the cause.

Meningococcus	Influenza bacillus	Colon bacillus
Staphylococcus	Tubercle bacilllus	Typhoid bacillus
Streptococcus	Glanders bacillus	Plague bacillus

Infrequently the Gonococcus, M. tetragenus, B. pyocyaneus.

The *Micrococcus Catarrhalis* is another small diplococcus, Gram-negative and intercellular, very common in catarrhal mucus from the nose, throat and bronchial tubes. Stain with Loeffler and Gram. The nature of M. catarrhalis is not well understood. It is believed by some to be a variety of meningococcus.

The *Influenza Bacillus* is found in the nasal secretion and in the sputum of many cases of influenza but is scarcely diagnostic unless abundant. It is found also in bronchitis and pneumonia and in many cases of phthisis but is often absent in cases that clinically are influenza. It is a minute, Gram-negative bacillus, lying both within and without the pus cells and stains with difficulty. Stain with one-tenth carbol-fuchsin or Loeffler, hot.

The *Diphtheria Bacillus* is best recognized after it has grown for 18 hours on blood-serum. Stain with Loeffler's blue for two minutes and wash in water. With this stain, the bacillus shows clubbed ends or swellings that take the stain more deeply than the rest of the bacillus. Differentiation from Hoffman's bacillus, the pseudo-diphtheritic bacillus, requires considerable experience. Specific stains, as Neisser's, are unreliable. Examiners in Health Board Laboratories depend on the Loeffler stain and the practised eye. The only sure differentiation between virulent and non-virulent diphtheria bacilli is by animal inoculation.

The disease, *Actinomycosis*, is caused by several varieties of streptothrix. Masses of this fungus are seen in pus or sputum as minute yellow granules. They may be examined fresh or chrushed between two slides to make a smear. They present a central skein of branching mycelium which radiates all around the margin. There are many spores in chains. The club-shaped forms may or may not be present. It is Gram-positive and acid-fast, like the tubercle bacillus, with which its mycelium should not be confused.

Stain with Gram, allowing the anilin-methyl-violet to stain for ten minutes, iodin for three minutes and, instead of alcohol, decolorize with a mixture of equal parts xylol and anilin oil. To make permanent preparations, wash several times with pure xylol, apply balsam and cover-glass.

For *Tubercle Bacilli*, see pages 109 to 116.

TABLE OF BACTERIA.

Reprinted by permission from Park and Williams', Pathogenic Micro-Organisms.

The more important bacteria from different parts of the body, in the order of frequency.

Serous Fluids.	Meningeal fluid (cerebro-spinal).	Micrococcus intracellularis.	Fluid generally cloudy with many leucocytes.
		Streptococcus (including pneumococcus group).	
		B. influenzæ.	
		B. tuberculosis.	Fluid generally clear.
	Pericardial and pleural fluid.	Streptococcus (including pneumococcus group).	Fluid may be cloudy.
		B. mucosus capsularis.	
		B. influenzæ.	
		B. tuberculosis.	Fluid generally clear.
	Peritoneal fluid.	B. coli group.	
		Streptococcus group.	
		B. tuberculosis.	
Lungs.		Streptococcus (including pneumococcus group).	
		B. mucosus capsularis.	
		B. influenzæ.	
		B. tuberculosis.	

Nose and Throat.	B. diphtheriæ group.
	B. influenzæ group.
	Streptococcus group.
	B. mucosus group.
	B. tuberculosis.
Fæces.	B. coli group (including B. fæcalis B. alcaligenes and B. acidi lactici).
	B. typhosus group.
	B. dysenteriæ group.
	Gram-positive anaerobes.
	Many forms whose importance has not been worked out.
Urine.	B. coli group.
	Streptococcus (kidney).
	M. gonorrhœae.
	B. typhosus.
	B. tuberculosis.
Pelvic Organs.	M. gonorrhœae.
	Streptococcus.
	B. tuberculosis.
	Many other forms, probably unimportant.

TABLE OF GRAM-POSITIVE AND GRAM-NEGATIVE BACTERIA.

GRAM-POSITIVE BACTERIA.

Reprinted by permission from Park and Williams' Pathogenic Micro-Organisms.

BACILLI.

B. diphtheriæ group. B. tetani (not often demonstrated in smears from lesion). B. tuberculosis. B. anthracis. B. lepræ. B. welchii and some other intestinal anærobes.	Generally marked indication of their presence in history.

COCCI.

Staphylococcus group. Streptococcus group (including pneumococcus and its variety, pneumococcus mucosus).	Some indication of their presence in history.

Micrococcus tetragenus.

SPIRILLA.

None.

GRAM-NEGATIVE BACTERIA.

Bacilli.

Most frequently found, and some indication of their presence in the case history.	B. coli group. B. typhosus group. B. dysenteriæ group. B. proteus. B. mucosus capsulatus.	Most frequently from intestinal tract.
	B. pyocyaneus. B. influenzæ. B. fusiformis.	Most frequently from chest contents.
Less frequently found, and generally a marked indication of their presence in the case history.	B. mallei. B. edematis (malignant œdema). B. of symptomatic anthrax. B pestis. B. of Morax–Axenfeld.	

Cocci.

Micrococcus intracellularis. Micrococcus catarrhalis. Micrococcus gonorrhœae. Micrococcus melitensis.	Generally marked indication of their presence in case history.

Spirilla.

S. Choleræ and allied forms.	Marked indication of presence of first form in history.
Mouth spirals.	Unimportant, unless indication of syphilis in history when Tr. pallidum should be looked for, page 93.

FORMULAE.

Methyl Violet.

To make a saturated alcoholic solution, dissolve 10 grammes of methyl violet in one ounce of alcohol and filter into a clean, dry dropping bottle. This is a permanent stock solution.

For use, dilute with water or prepare as Gram's stain.

For use as simple stain, pour twenty drops of water on smear.

Add one drop of the stock solution. Mix on slide.

Stain one minute. Wash in water.

Loeffler's Methylene Blue.

Saturate 10 c.c. alcohol with methylene blue.

To 1 ounce of water, add one drop liquor potassæ and filter into it the 10 c.c. of alcoholic methylene blue solution.

Mix and filter into clean, dry dropping bottle.

For use, pour sufficient Loeffler blue over the smear.

Stain 2 minutes. Wash in water.

Manson's Borax Blue.

To make the stock solution, dissolve 25 grains of borax in 1 ounce water.

Add 10 grains of methylene blue. Dissolve and filter into dropping bottle.

This stain keeps for a long time and by some is preferred to Loeffler for general bacterial staining.

For use, dilute with five volumes water. On the fixed film mix two drops of the stain and eight drops of water. Stain two minutes. Wash in water.

GRAM STAIN.

MUST BE MADE FRESH EACH DAY.

In a clean test tube, shake vigorously 10 drops anilin oil in 2 drams of water.

Filter through wet filter paper into another clean test tube. The filtrate must be clear.

To the filtrate, add 10 drops saturated alcoholic solution methyl violet. Mix.

Pour this anilin-methyl-violet on slide. Stain 3 minutes.

Pour off, and, without washing, pour on film sufficient Gram solution of iodin to cover the film.

Stain until film turns black, about 2 minutes.

Pour off iodin.

Flood slide with 95% alcohol a number of times until no more violet color comes away. Wash in water.

Counter-stain 5 minutes with weak carbol-fuchsin or saturated aqueous solution of Bismarck brown.

GRAM'S SOLUTION OF IODIN.

Iodin crystals	0.4 gramme
Potassium iodid	0.8 "
Water	120. c.c.

Mix. This solution keeps indefinitely.

WEAK CARBOL-FUCHSIN.

On the smear, pour 20 drops of water. Add 1 drop strong carbol-fuchsin. Mix. Stain 5 minutes. Wash in water.

This is a good counter-stain for Gram or any blue stain. In this strength, it will not stain tubercle bacilli. For strong carbol-fuchsin, see page 111,

SPUTUM.

Formerly we studied the morphology of sputum and neglected the microbes. Of late, we have studied the microbes and neglected the morphology. By far the most important object in sputum is the tubercle bacillus but it is unfortunate that the search for these bacilli in sputum has overshadowed everything else.

Elastic Fibers from the Lung.

For many years before the discovery of the tubercle bacillus, the finding in the sputum of elastic fibers from the lung was an important diagnostic sign of tubercular ulceration. This finding is still helpful in those few cases of tuberculosis in which the tubercle bacilli are scanty or apparently absent; also in those rarer destructive lesions of the lung, abscess and gangrene. The sputum of gangrene must be examined fresh, as the elastic fibres are soon dissolved by the ferments present. In tuberculosis, the presence of the elastic fibers differentiates the milder superficial processes from ulceration. Moreover, the increase or decrease of elastic fibers in the sputum is of distinct prognostic value.

Finding Elastic Fibers.

Required: 10% solution of caustic soda (the strong NaOH of the urea test diluted with four parts water.)
5 ounce beaker.
Bunsen flame and wire gauze.
Conical glass for precipitation or a centrifuge.
Microscope, with dry lenses of high and low power.

Test: Boil the sputum with equal parts of the caustic soda until it is liquified. To prevent cracking while boiling, rest the beaker on wire gauze.
Add five or ten volumes water to reduce the specific gravity.
Set aside to precipitate in the conical glass; or centrifuge.
Examine the sediment with microscope.

Interpretation: The elastic fibers are arranged in curly bunches, often retaining the form of the alveoli.

Boiling with caustic soda dissolves most fibrous-looking elements in the sputum except wool or those of vegetable origin. Fibers of cotton, linen or wool, the spiral fibers of vegetable tissues, the leptothrix and moulds may confuse the inexperienced. The only protection against these sources of error is to examine sputum often enough to become familiar with them.

Elastic fibers are also found by pressing the sputum between two glass plates. Against a dark background, minute bits of tissue can be selected and examined microscopically without boiling in soda.

Curschmann's Spirals.

Curschmann's spirals are found in sputum of true spasmodic asthma but are not present at all times. They are apt to be found at the end of the paroxysm when the discharge increases but are absent between the attacks. They present a central core around which are spirals of mucus entangling Charcot-Leyden crystals and leucocytes, especially eosinophiles.

Charcot-Leyden Crystals.

Charcot-Leyden crystals are also found in the sputum of asthma. Their chemical composition is uncertain. They crystallize out slowly. If not found in fresh sputum, they may appear after it has stood for a time.

Alveolar Cells.

Alveolar cells from the walls of the air-cells are found in all sputum. Like all epithelia, they are exfoliated normally. The alveolar cells are two to four times the size of a leucocyte, oval, coarsely granular and contain large nuclei. They are apt to contain coal dust or any foreign material that enters the respiratory tract.

In the prolonged passive hyperæmia of the lungs that attends gradual failure of the heart-muscle, numerous small hæmorrhages occur. In this case, many of the alveolar cells contain yellowish granules, derivatives of hæmoglobin. These are the so-called heart-failure cells.

TUBERCLE BACILLI.

The tubercle bacillus is the most notable member of the group known as acid-fasts. They are surrounded by a wax-like coating. The bacilli stain with difficulty but when once stained, the waxy coating hinders their decolorization with mineral acids, which decolorize all other bacteria instantly.

In staining acid-fast bacilli, there are three distinct steps:

Staining everything in the specimen;

Decolorizing everything except the acid-fasts;

Counter-staining all bacteria and cells which have lost their color in the acid decolorizer.

All acid-fast bacilli stain alike. The only protection against confusing tubercle bacilli with the others is the great prevalence of tubercle bacilli in the human body and the comparative rarity of the others.

Other acid-fasts that stain like tubercle bacilli are:

The *grass, timothy or hay bacilli.* Common in milk and butter. Differentiated by their easy and rapid growth on culture media.

The *smega bacillus.* Decolorizes with alcohol much more quickly than the tubercle bacillus.

The *leprosy bacillus.* Stains easily with cold carbol-fuchsin but resists decolorizing with acids.

Of the various methods of staining tubercle bacilli, there is none so reliable as the Ziehl-Neelson, which has stood the test of many years of use in the hands of thousands of examiners, skilful and unskilful. In this method, the three steps of staining, decolorizing and counter-staining are conducted separately. The degree of decolorizing and of counter-staining can be controlled.

"Rapid methods," as those of Gabbett and Pappenheim, combine decolorizing and counter-staining. They are only a few seconds more rapid and have the disadvantage that decolorizing, either with acid or alcohol, cannot be watched and controlled.

STAINING TUBERCLE BACILLI.

Carbol-fuchsin or Ziehl-Neelson Method.

Required: Glass slides and clip for holding them while heating.
Bunsen flame.
Carbol-fuchsin.
Loeffler methylene blue or a saturated watery solution of methylene blue.
Decolorizer; 25% nitric acid or 15% sulphuric acid in wide mouth bottle.

Staining: Spread in a thin layer the thickest bits of sputum or pus or centrifugalized sediment of urine by pressing between two glass slides and sliding them apart.
Dry in air without heat.
Fix smear to slide by passing three times over the flame.
Holding slide in clip, cover film with carbol-fuchsin (strong).
Heat over flame for 2 minutes, letting the stain steam but not boil, adding more stain to prevent drying.
Wash in water.
Dip in acid decolorizer ½ minute or until red color disappears.
Wash in water.
If any red color returns in washing, immerse again in the acid and wash in water, repeating this until all red color has gone or until only the thickest parts of the film have a faint pink tint.
If a urinary sediment, cover with absolute alcohol 1 minute to decolorize smegma bacilli.
Cover film with Loeffler blue, 2 minutes.
Wash in water. Dry in air.
Place drop of immersion oil directly on smear and examine without cover-glass.

Tubercle bacilli are stained red; corpuscles, epithelia and all other bacteria are blue. The examiner should become familiar with fuchsin crystals and vegetable fibers that often retain the red color and may be confused with tubercle bacilli.

For permanent preparations, place a drop of Canada balsam instead of immersion oil directly on smear and apply a cover-glass.

The bacilli can be stained cold by soaking 24 hours in carbol-fuchsin at room temperature. Decolorize and counter-stain as before.

FORMULAE.

Carbol-fuchsin (Ziehl-Neelson.

A 1% solution of fuchsin in 5% carbolic acid water.

Fuchsin	1 dram
Alcohol	1 oz.

Mix and filter.

Keep as stock solution. It keeps indefinitely.

Carbolic acid	25 drops
Water	1 oz.

Mix and filter.

Add 1 dram of the alcoholic fuchsin solution. Mix and filter into a 1 ounce dropping bottle.

One ounce is a convenient quantity to make up for office use. In a hospital where many specimens are examined, mix 3 drams carbolic acid with 8 ounces of water and add 6 drams of the alcoholic fuchsin solution.

DECOLORIZER.

Nitric acid	1 oz.
Water	3 oz.

Mix and keep in a wide-mouth four-ounce glass-stoppered bottle. The mouth should be large enough to admit a slide. When not in use, the decolorizer should be kept stoppered and can be used many times until it begins to decolorize feebly.

GABBETT'S METHOD.

After staining with carbol-fuchsin and washing in water, immerse in the following solution for 1 minute and wash in water.

Sulphuric acid	4 drams
Water	12 drams
Methylene blue	20 grains

Mix and filter. Keep in wide-mouth, 2 oz. glass-stoppered bottle.

PAPPENHEIM'S METHOD.

After staining, do not wash in water but pour the Pappenheim solution over the slide five times.

Rosolic acid	20 grains
Absolute alcohol	4 oz.

Saturate with methylene blue and add 2 drams glycerin.

Mix and filter.

FINDING SCANTY BACILLI.

In sputum, pus or tissues, tubercle bacilli are often so abundant that they are found at once in smear or section. At other times, they are scanty and so difficult to find that the examiner gives up the search; though, from the clinical symptoms, quite certain that the lesion is tubercular.

In this difficulty, the bacilli may be found more easily if concentrated. Bacilli are concentrated either by precipitating them to the bottom or lifting them to the top of their enclosing medium.

For precipitating the bacilli to the bottom, the older methods were to liquefy the sputum or pus by heating with equal parts liquor potassæ until liquefied, add water or alcohol to reduce the specific gravity of the liquid and set aside to precipitate or separate by centrifuge; or shake vigorously with ten volumes of 5% carbolic water and set aside to precipitate. These methods are now superseded by the antiformin method described on the next page.

For carrying the bacilli to the top, advantage is taken of the adhesion of the wax-like coating of acid-fast bacilli to minute drops of oil. When a mixture of different bacteria is shaken with a light hydrocarbon oil, as xylol or benzine, and the mixture set aside, the oil drops rise to the top carrying with them the bacilli to which they have adhered. The same separation takes place in a watery solution of sputum or pus. This principle is best applied in the combined antiformin-ligroin method described on page 115.

FINDING SCANTY BACILLI. THE ANTIFORMIN METHOD.

Antiformin is a patented mixture of equal parts liquor sodæ chlorinatæ and a 15% solution of sodium hydrate. It has remarkable liquefying power, not only on sputum and pus but also on animal and vegetable tissue of all kinds. It dissolves all the common varieties of bacteria except tubercle bacilli and the other acid-fasts, which resist liquefying beyond a 50% solution. Thick sputum, pus, feces, or bits of solid tissue as liver, tonsil or glands containing tubercle bacilli, are dissolved, liberating the tubercle bacilli, which can then be precipitated by centrifuge or separated out by ligroin, xylol or benzine.

Dissolve the sputum in 30% to 50% antiformin. The thicker the sputum, the stronger must be the antiformin. Shake frequently for one hour. Reduce the specific gravity with alcohol and set aside to precipitate or centrifugalize.

Wash the sediment several times with water, as the antiformin, like all alkalies, does not adhere well to the slide.

Spread the sediment on a slide. When dry, cover with a layer of the same sputum so that it will not be washed off.

Fix by heat and stain with carbol-fuchsin, page 110.

FINDING SCANTY BACILLI. ANTIFORMIN-LIGROIN METHOD.

Ligroin is a light hydrocarbon oil. When a light hydrocarbon is shaken with a liquid containing tubercle bacilli, the bacilli adhere to the minute drops of the oil. When the oil drops rise to the top of the mixture, the tubercle bacilli are carried along with them and are found at the junction of the oil and the water.

Required: Cylindrical graduate, 50 c.c:, with stopper.
Antiformin.
Ligroin (or benzine or xylol.)
Platinum loop.

To 5 c.c. of sputum in the graduate add 20 c.c. of a 20% to 50% solution of commercial antiformin. Stand at room temperature (more quickly in an incubator) until fully liquefied, shaking frequently, one-half to several hours.

Add 25 c.c. of water. (This is advisable but not necessary.)

Add enough ligroin to make a layer 3 to 5 millimeters thick.

Shake strongly to a thick emulsion.

Stand at room temperature until sharply separated; 20 to 30 minutes.

A number of loopfuls from the junction-layer are placed on the same spot on a warmed slide. The ligroin evaporates and the bacilli of many drops are concentrated on one spot.

Cover with layer of the same sputum to prevent washing off.

Fix by heat and stain with carbol-fuchsin, page 110.

THE "DUST-LIKE FORM" OF THE TUBERCLE BACILLUS AND THE TUBERCLE BACILLI THAT DO NOT STAIN WITH ZIEHL-NEELSON.

In 1907, Dr. Much, of von Behring's laboratory, announced that the tubercle bacillus exists in the form of "dust-like heaps" and bacilli that do not stain with Ziehl-Neelson. Found in sputum and in smears and sections of tubercular material. This may explain the apparent absence of tubercle bacilli in tissue or sputum from known tubercular subjects. Further confirmation is required. Methyl violet BN is a special dye now obtainable in this country.

Much's Gram II.

1 c.c. of a saturated alcoholic solution of methyl violet BN in 10 c.c. 2% carbolic acid water.
Boil over the flame a few minutes or soak 24 to 48 hours at room temperature.
Gram's iodin solution, 1 to 5 minutes.
5% nitric acid, 1 minute.
3% hydrochloric acid, 10 seconds.
Aceton-alcohol, equal parts; decolorize until no more stain is extracted.
Wash in water.

Much's Gram III.

Methyl violet BN solution same as Gram II. Boil or stand 48 hours at room temperature.
Iodid of potash-hydrogen dioxide solution (five grains of iodid of potash in 100 c.c. of 2% hydrogen dioxide) 2 minutes.
Absolute alcohol.

DIAGNOSTIC PUNCTURE.

In puncture diagnosis, an ordinary hypodermic syringe of 20 drops capacity is sufficient, though one of 5 c.c. or 10 c.c. is better when large amounts of fluid are required for laboratory examinations. For everything except lumbar puncture, the needle should be 24 guage, 1¼ inch long. For lumbar puncture, no syringe is used; the needle should be the special lumbar puncture needle of Quincke or any long heavy needle, 18 or 16 guage or larger, 3 to 4 inches long.

The only satisfactory syringe is the all-glass syringe with ground glass piston and a slip needle. Avoid syringes of combined glass and metal with leather or asbestos packing and needles with screw threads. They always leak.

Before all punctures, the hands of the operator and the skin of the patient should be cleaned with alcohol or ether and the syringe and needle must be boiled for 5 minutes.

After puncture, a drop of iodin tincture or sublimate solution may be applied to the wound followed by collodion or a gauze pad.

Fluid from puncture should be preserved in sterile test tubes or bottles. It is well to make several smears on slides and to inoculate culture media at once before the fluid coagulates. See further Cyto-Diagnosis, page 124.

To obtain specimens of tissues or tumors, use a needle of large bore, rotate the needle in the tissue and at the same time push it in and out. Tease the bit of tissue on a slide.

Diagnosis by exploring puncture is applied to:

The brain	The peritoneum
The pleura	The joints
The lung	Syphilitic glands
The pericardium	The spinal canal (lumbar puncture)
The spleen	

Of these locations, brain puncture requires careful localization and is a matter for the expert neurologist. The other punctures require no more skill than that possessed by every physician.

PUNCTURE OF THE BRAIN.

Cerebral puncture is performed by exposing the skull and puncturing through a hole drilled in the bone. It has been done under local anæsthesia.

The objects are to determine the pressure in the lateral ventricles; to obtain fluid from the lateral ventricles; and the diagnosis of cerebral abscess, tumor, hæmorrhage and meningitis.

PUNCTURE OF THE PLEURA.

Select as the point of puncture the point of greatest dulness, usually in the eighth or ninth intercostal space between the posterior axillary line and the scapular line or the fifth or sixth space in the anterior axillary line.

Clean the patient's skin and have him lie on his back while the operator cleans his hands and gets the syringe ready. In this position the fluid settles towards the back. When the patient sits erect or leans forward, small quantities of pus or exudate flow forward and escape detection.

When ready, the patient sits up or lies on the side opposite to the one to be punctured. Make the puncture before the fluid has time to flow forward. Puncture close to the upper border of a rib to avoid the vessels that lie beneath the lower border.

Except perhaps with children, local anæsthesia by freezing is seldom necessary. The injection of cocain has its dangers and is never necessary.

When the needle is in place, draw gently on the piston. If fluid is present, it will appear in the syringe. If there is resistance to withdrawing the piston, there may be pus too thick to flow through the needle or the needle may be in solidified lung. In the latter case, there is no danger of damaging the lung. If air is withdrawn into the syringe, either the needle is in air-filled lung or the syringe leaks. Here, too, no damage to the lung need be anticipated.

PUNCTURE OF THE LUNG.

Puncture of the lung is performed in lobar pneumonia to collect a specimen for bacteriological diagnosis and for the administration of the autogenous virus as a treatment. Lung puncture is also useful in diagnosis. Not a few cases of upposed pulmonary consolidation or delayed resolution, prove to be serous or purulent pleural exudate.

The technique is the same as puncture of the pleura. Only a few drops of blood-stained serum are obtained, sometimes only enough to fill the needle. These are either injected into the general circulation or spread on a culture medium. The fluid obtained from lung puncture is sometimes sterile, even in patients with high fever and fatal termination.

PUNCTURE OF THE PERICARDIUM.

Puncture of the pericardium should only be done when the physical signs give a reasonable probability that the pericardial sac is distended with fluid and then only for the relief of pressure. The puncture may be performed in the fourth intercostal space to the right of the sternum, or the fifth space to the left of the sternum or at the extreme left border of the dulness, beyond apex beat if possible, in the fifth space.

Puncture straight backward in the sagittal plane. The fluid is usually near the surface. When the needle moves freely as in a sac, stop pushing and test for fluid.

PUNCTURE OF THE SPLEEN.

Puncture of the spleen is done to obtain specimens of fluid for the early diagnosis of typhoid fever or for the diagnosis of malaria. Often, but not invariably, typhoid bacilli can be cultivated from the splenic blood in the first week of the disease. See page 87.

The patient lies on the right side. Select the point for puncture in the tenth intercostal space in the posterior axillary line. By percussion, make sure that this is the center of splenic dulness. The patient should hold the breath at the end of an ordinary expiration and the puncture should be done quickly while the spleen is held motionless. Theoretically, there is danger of tearing the splenic capsule if the spleen moves up and down with respiration. Cases of fatal rupture of the spleen, especially malarial spleen have been reported. Practically, in patients with delirium or foreigners who could not be instructed to hold the breath, the author has punctured the spleen many times without this precaution. No accidents have happened. The needle simply rocks up and down with the respiratory movement of the spleen.

Puncture quickly to the full depth of the needle. Pump the piston up and down a few times and withdraw the needle.

Only a few drops of blood will be obtained. These are expelled into bouillon or Conradi's medium for culture. If there is not enough fluid to expel, drop the needle into the bouillon.

PUNCTURE OF THE PERITONEUM.

To avoid leakage of infectious contents into the peritoneum, diagnostic puncture of apparent cysts in the abdomen is better avoided, unless they are adherent to the abdominal wall. Any free abdominal cyst that requires diagnostic puncture requires an exploratory laparotomy, which is safer, more conclusive for diagnosis and perhaps curative at the same time.

It should be remembered that in fluid from pancreatic, biliary and renal cysts, the characteristic ferments or urea may have disappeared.

Tapping for Ascites.

Here, a fine needle is seldom necessary for diagnosis, the physical signs of fluid in the abdomen being usually reliable. Use a trocar and canula.

The presence of fluid in the abdomen should be demonstrated by the succussion wave and by the better sign that the percussion dulness changes with the position of the patient, the dulness shifting to the lower side.

Before puncture, never forget to empty the patient's bladder.

The patient sits on a chair leaning forward. Clean the skin of the lower abdomen with alcohol or ether. The operator should wash his hands and clean them with alcohol or ether. The trocar should be boiled. Have brandy or other stimulant ready in case the patient becomes faint.

Puncture midway between the umbilicus and the pubis. Withdraw the stylet and the fluid usually flows freely. If no fluid flows, introduce a sterile probe or the stylet to clean the canula.

Do not withdraw the fluid rapidly. With large amounts, pause occasionally to allow the intra-abdominal pressure forces to adjust themselves.

In case of colloid cancer, the fluid may be too thick to flow. In this case, apply suction. In one such case, the author had made a glass cup of one quart capacity to which was attached a small suction pump. It answered admirably many times.

PUNCTURE OF JOINTS.

Puncture of joints is performed for early diagnosis of the nature of arthritis as well as for the injection of medicated solutions. The fluid of synovitis and arthritis is generally sterile, the bacteria burying themselves in and beneath the synovial membrane.

With persistent pain and swelling of a joint unrelieved by treatment, where puncture indicates solid tissue, consider the possibility of sarcoma.

SYPHILITIC GLANDS.

In the early diagnosis of primary or secondary syphilis, the swollen glands are punctured to find the treponema pallidum.

Puncture the gland in its long axis. Demonstrate that the needle is in the gland by moving the gland. The needle moves with it. Pump gently up and down with the piston while the gland is kneaded and squeezed. A few drops of serum are obtained, probably only sufficient to fill the needle. A drop of the serum is mixed with India ink or smeared on a slide for staining. See pages 93 to 95.

LUMBAR PUNCTURE.

Lumbar puncture, puncture of the spinal canal, is performed in spinal anæsthesia; and to determine the pressure and to secure a specimen of cerebro-spinal fluid in meningitis, brain tumor, syphilis of the nervous system, locomotor ataxia and general paralysis. In infants and children, it is very easy. The spaces between the spinous processes are wide and the spinal canal very near the surface. In adults, the thickness of the lumbar muscles and the greater development of the vertebral laminæ make lumbar puncture more difficult; but it is not a dangerous procedure and, with a little patience and care, the spinal canal can be tapped at any age.

In lumbar puncture, no suction should be used. The needle should be long and heavy. In infants, 18 guage, 2½ inches long is sufficient. For adults, the needle should be 16 guage or heavier and 3 to 4 inches long. The regular Quincke lumbar puncture needle is most satisfactory for all ages. The needle should have a stylet to clear obstructions and its outer end should be shaped to receive a small nozzle attached to a rubber tube. To determine the pressure in the spinal canal, have at hand two feet of small rubber tubing, 1 to 2 mm. in diameter, attached to a small nozzle that fits the socket of the needle. An extra two-foot length of tubing with glass tube for connecting is convenient for very high pressures.

Clean the hands of the operator and the skin over the lumbar spine with alcohol or ether. Boil the needle, its stylet and the rubber tube.

The body of the patient should be arched forward to widen the lumbar spaces as much as possible. An infant should lie over the nurse's shoulder, presenting its back to the operator. An adult should sit across a chair leaning well forward or lie on one side with the trunk bent forward. A line drawn across the spine at a level of the highest points of the crests of the ilia will cross the spinous process of the fourth lumbar vertebra. Puncture in the fourth or third lumbar space.

In infants, puncture in the middle line midway between the vertebral processes. Direct the needle straight forward. In adults, puncture ¼ inch on either side of the median line on a level with the upper border of a spinous process. Direct the needle forward and a little inward and upward to enter between the slanting vertebral laminæ.

After puncture of the skin and muscles, there is felt the resistance of the tough spinal ligaments. Then the needle slips freely into the spinal canal. In infants, the distance is about half an inch; in adults from 2 to 3 inches.

Below the level of the second lumbar vertebra there is no danger of injuring the spinal cord which is represented below this point by the cauda equina, hard cords, hanging free and simply pushed aside by the needle.

When the needle enters the spinal canal, the spinal fluid drops or spurts freely. If the fluid spurts, attach the rubber tube and determine how high a column of fluid the pressure will sustain. Raise the tube until the flow stops. The vertical distance between the tip of the needle and the top of the rubber tube gives the pressure n m.m. or inches of water. Normally, the pressure will sustain a column 60 to 150 mm. (3 to 7 inches) high. In meningitis, brain tumor or uræmia, the pressure may be increased to 200 or 800 mm. (10 to 40 inches). A rough estimate of increased pressure may be made by the force with which the fluid squirts from the needle. Normally, it drops slowly.

Make smears and cultures from the fluid as it drops from the needle. If the fluid is clear, centrifugalize and make smears from the sediment. Have on hand sterile two-dram bottles and corks to preserve the fluid for examination. Withdraw the needle and apply sterile gauze or seal the puncture with collodion.

Normal spinal fluid is as clear as water except when the needle happens to wound a vein, when it is turbid from blood. Except when mixed with blood, it contains only a trace of albumin and scanty corpuscles or none. The specific gravity is about 1.003.

The fluid from tubercular meningitis may also be clear and watery. Lymphocytes are found in the sediment and tubercle bacilli, though scanty.

Besides tubercular meningitis, abundant lymphocytes are found in syphilitic leptomeningitis, in progressive paralysis, in locomotor ataxia, multiple sclerosis, some cases of zoster and chronic non-septic meningitis, differentiating the early stage of these disorders from neurosis.

Fluid from other types of meningitis is turbid, albuminous and on microscopic examination presents pus corpuscles, blood corpuscles and the causal organisms, which may be any one of the following.

Meningococcus	Influenza bacillus	Glanders bacillus
Staphylococcus	Colon bacillus	Plague bacillus
Streptococcus	Typhoid bacillus	Pneumococcus

Infrequently, the Gonococcus, M. tetragenus, B. pyocyaneus.

CYTO-DIAGNOSIS.

Cyto-diagnosis is the attempt to determine the nature of a morbid process by a study of the cells in a puncture fluid or discharge. Such study of the cells in the urine is a form of cyto-diagnosis that has been long practised. Recently, fluid from the pleura, from the peritoneum and the cerebro-spinal fluid have been especially studied. The results of the examinations are interesting but, except the lymphocytosis of syphilis, not yet of diagnostic importance.

The sediment of puncture fluid, obtained by centrifuge or gravity, is spread on a slide and stained like a blood-film with Jenner or other blood stain. See pages 81 to 83.

The elements observed are:

Red blood cells
Polymorphonuclear leucocytes
Lymphocytes
Endothelial cells

Like macroscopic blood, abundance of *red cells* suggests cancer or tuberculosis but may simply be from wounding a vessel during puncture. Normal cerebro-spinal fluid is sometimes turbid from this cause.

Preponderance of *polymorphonuclear leucocytes* indicates acute inflammation.

Preponderance of *lymphocytes* in pleural or peritoneal exudate suggests tuberculosis. In cerebrospinal fluid, an abundance of lymphocytes is found not only in tubercular meningitis but also in syphilis of the central nervous system and the parasyphilitic disorders, general paresis and locomotor ataxia. It is an early and useful sign.

An abundance of *eosinophiles* is occasionally seen. Its meaning is unknown. It does not correspond with an eosinophilia in the general circulation.

Endothelia appear as large round or polyhedral cells, often phagocytic, enclosing a red cell or bacteria. They are abundant in mechanical transudates or effusions.

Cells of tumors cannot be recognized or distinguished from distorted endothelia. If a shred of fresh tumor tissue should be found, a diagnosis could be made but usually any tissue that separates from the tumor is so necrotic as to be unrecognizable.

The original proposition of cyto-diagnosis that, in pleural exudate, lymphocytosis indicates tuberculosis and polymorpholeucocytosis means non-tubercular inflammation is untenable. All fresh exudates have an excess of polymorphonuclears. Old exudates present an excess of lymphocytes. As many tubercular pleurisies are of insidious onset and chronic course, they present a lymphocytosis but this is a sign of chronicity and not of tuberculosis.

THE ORAL AUSCULTATION OF TAKATA.

In the Berliner Klinische Wochenschrift of January 8, 1912, Dr. Koan Takata, of Japan, described his method of diagnosis by oral auscultation, using a binaural stethoscope with the usual trumpet-shaped chest piece. Lying flat on the back with the mouth wide open and the tongue protruded, the patient breathes deeply and very slowly. The examiner pinches the patient's nostrils gently so that all breath comes through the mouth. Holding the end of the stethoscope close to the pateint's mouth, the examiner can hear the normal breathing sounds, dry and moist bronchial rales and crepitant rales in the air cells. Sometimes the sounds of the heart can be heard also but not uniformly enough to be of much value in diagnosis. Confusion of bronchial and crepitant rales with bubbling mucus in the pharynx is avoided partly by inspecting the pharynx during auscultation and partly by the duration and fineness of the crepitant rales which the exam ner soon learns to recognize. Pleuritic friction sounds are not transmitted.

Takata claims that this method is of value in the early diagnosis of catarrhal phthisis and of central pneumonia, in both of which rales may be inaudible through the chest wall; and also in differentiating between fine friction sounds and crepitant rales in the air cells, a differentiation which, at times, is not as easy as it might seem.

Oral auscultation is interesting, but the author finds its results very irregular. In some cases of pneumonia and bronchitis, the rales were heard distinctly at the open mouth but, in a long series of cases of phthisis, the method failed though crepitant rales were heard distinctly on auscultating the chest wall. In applying oral auscultation, it is important that the patient lie on the back and breathe deeply, the mouth wide open, the tongue protruded and the nostrils closed.

THE VERTEBRAL AUSCULTATION OF D'ESPINE.

In infants and children, tuberculosis usually appears in the chest in the form of enlargement of the mediastinal glands rather than the familiar apical consolidation of the adult. Enlargement of the glands in the anterior mediastinum is detected by percussion dulness over the manubrium. D'Espine noted that, when enlarged in the posterior mediastinum, these glands touch the vertebræ. They conduct bronchial breath'ng and bronchophony to the vertebræ where these sounds are easily heard with the stethoscope.

With the stethoscope over the cervical vertebræ, have the child count or say 99. The crying of infants serves equally well. The vocal resonance is loud and tracheal in character. Place the stethoscope over the spinous process of each vertebra successively downward. In health, the tracheal character of vocal resonance ceases abruptly between the seventh cervical and the first dorsal vertebra. Tubercular and other tumors of the mediastinum conduct the sound much lower so that it is heard over the first, second or third dorsal vertebra.

AUSCULTATORY TOPOGRAPHIC PERCUSSION.

Topographic percussion is the outlining of the viscera by their percussion note. It may be performed by simple percussion or with a stethoscope. Topographic percussion with a stethoscope is auscultatory topographic percussion. Any stethoscope of the resonance type may be used. The phonendoscope with the rod is best. The most delicate of all is Smith's modification of the phonendoscope with a shutter for the admission of air.

Auscultatory topographic percussion enjoys the distinction of being condemned by every noted clinician in Europe and ignored by most clinicians in this country. Nevertheless, it is a most useful method of outlining the viscera, confirming or correcting the results of finger percussion. It is a method easily learned and indispensable when skill is acquired.

The beginner should practice on the lower border of the liver especially an enlarged liver in a case where the abdominal walls are thin so that the accuracy of the work can be controlled by palpation and inspection.

Place the stethoscope over the liver. With a small stiff brush, like a mucilage brush or with the tip of the finger, stroke the skin gently over the liver, near the stethoscope and parallel to the border of the liver. Through the stethoscope, this sound is heard as a loud scratching. Now stroke further and further away from the stethoscope in the direction of the lower border of the liver. The sound becomes fainter but where the stroke crosses the border of the liver there is an abrupt change in the character as well as an abrupt diminution in the loudness of the sound. Stroke back toward the stethoscope. On crossing the border of the liver there is a similar abrupt change in character of the sound and it becomes louder. Stroke toward the lower border of the liver at various angles and mark the points where the sound changes. If the examiner is successful, these dots will correspond to the lower border of the liver. Confirm by palpation and finger percussion and by demonstrating the respiratory mobility of the supposed lower border of the liver.

Having practiced on the liver, try to outline the heart. Place the stethoscope in the fourth intercostal space between the edge of the sternum and the left nipple. This is surely over the heart. From this point stroke in different directions, dotting the points where the sound changes. Confirm this outline of the heart by finger percussion and by locating the apex beat. Avoid confusing the right border of the sternum with the right border of the heart.

In a similar manner, outline the spleen and stomach. On account of the thick lumbar muscles, the kidneys cannot be outlined.

Sources of error: The chief objection to this method is that the area of loud sound around the stethoscope is misleading; that a heart can be outlined on any part of the body. Another source of error is that the sternum or ribs conduct the sound so that what appears to be the border of the heart or liver or spleen is really the border of a rib; and another is that if the skin is drawn tight as by raising the arm, the tightly-stretched skin like a tightly-stretched drum-head will have a sound of its own that will carry the examiner far beyond the margin of the heart. Like a relaxed drum-head, a relaxed skin gives no sound.

To know these different errors is to avoid them. To avoid confusion with outlines of bones, avoid the bone and stroke over the intercostal spaces. This is easily done by attaching the rod to the phonendoscope. To avoid the percussion note of a tightly stretched skin, have the patient lower the arms and place the body and limbs in a position in which the skin over the part is relaxed. If the skin should be distended with dropsy or inflammatory exudate or if the skin and muscles should be rigid, auscultatory percussion is inapplicable to the case.

The most serious objection is that auscultatory percussion indicates organs where there are none. It is true that the nearer one goes to the stethoscope the louder is the sound and consequently there is always an area around the stethoscope where the sound is louder than it is further away; but the area of resonance around the stethoscope shifts with the stethoscope while the border of an organ remains in the same place. Mark the point where the sound changes, which you consider to be the edge of the organ outlined. Now move the stethoscope nearer the place outlined and stroke again. If the supposed outline moves with the stethoscope, it is simply the area around the stethoscope. If it is the border of an organ, there will still be an abrupt change of the sound at that point no matter where the stethoscope is placed as long as it is still over the organ. Hence the rule in outlining an organ, take the observation from two or three different points. An abrupt change of sound which remains in one location is surely the border of the underlying viscus.

PERCUSSION OF THE APEX OF THE LUNGS.
KRÖNIG'S METHOD.

Measuring the Width of the Apices.

Useful in the early diagnosis of fibroid phthisis where rales are absent and percussion dulness is slight or masked by local emphysema. Practice on a thin patient with normal lungs. Lay the finger across the shoulder in an antero-posterior direction a little above the acromio-clavicular articulation. Percussion will give the resonance of the apex of the lung. Move the finger a little higher and percuss each finger-breadth until resonance is replaced by the dulness of the muscles in the neck. Mark this point. Percuss the front and back of the shoulder in the same manner and mark the points where resonance is lost. A line connecting these points will represent the inner border of the apex of the lung. Normally, this line ends anteriorly at the sterno-clavicular articulation and posteriorly at the first dorsal vertebra.

Percuss down toward the shoulder. Resonance will be lost at the angle between the acromion process and the clavicle. Mark the line where resonance is lost. This represents the outer border of the apex as far as available by percussion.

These lines representing the outer and the inner border of the apex are curved with their convexities towards each other. The narrowest width of this figure of the apex of the lung is along the anterior border of the trapezius muscle. This is called the isthmus of the apex. In health, the isthmus varies with the width of the shoulders, usually measuring 2 to 3 inches, seldom as narrow as $1\frac{3}{4}$ inches or as broad as 4 inches. The important point to note is that in health the apices are equal in width. In fibroid phthisis, the percussion area of one or both apices measured along the anterior border of the trapezius muscle is contracted and one side is narrower than the other.

This method is not applicable to cases of early catarrhal phthisis. These show little or no change in the width of the apex but the abundant crepitant rales and percussion dulness are sufficient for diagnosis. The border of the apex of the normal lung is sharply marked. In catarrhal phthisis, it shades gradually into the dulness of the surrounding muscles.

Narrowing of the apex is not a specific sign of tuberculosis. It is a sign that some influence has contracted one or both apices. In the majority of instances, this influence is either fibroid phthisis or chronic pleurisy and chronic pleurisy itself is nearly always tubercular.

GOLDSCHEIDER'S METHOD.

A delicate method of detecting percussion dulness of the apex. Useful in the early recognition of pulmonary tuberculosis.

The supraclavicular fossa is crossed by the first rib, which encircles the apex of the lung.

With the patient's head bent forward to relax the muscles, palpate the supraclavicular fossa and locate the first rib. Percuss it lightly. Compare with the opposite side and with a normal apex.

The tip of the lung within the encircling first rib is the true apex. It is covered by the sterno-cleido-mastoid muscle but can be percussed between the sternal and the clavicular heads of this muscle.

With the patient's head bent forward to relax the muscles, press a plessimeter or the crooked finger-tip between the sternal and the clavicular heads of the sterno-mastoid. Press backward and a little outward to avoid the resonance of the trachea and the dulness of the clavicle. Percuss *lightly* with the middle finger of the other hand. Compare the note with the opposite side and with a normal apex.

THE RECTAL BOUGIE.

Some cases of pain in the lower abdomen, of constipation and of diarrhoea, especially early morning diarrhoea, that resist treatment by diet and remedies by the mouth, are due to a catarrhal inflammation or ulceration of the sigmoid flexure. These cases are best diagnosed and treated by the Wales rectal bougie, which is tunneled for the injection of fluids through it.

DIAGNOSIS.

Required: Wales' rectal bougies with olivary tips, sizes 4, 6, 7 and 8.
Hard rubber syringe, 4 or 8 ounce capacity
Vaseline or other lubricant
Warm water containing a pinch of salt or bicarbonate of soda.
Rubber finger-cots.

PASSING THE BOUGIE.

The patient lies on the left side with the right knee drawn up and the left leg extended as in Sims' position.

Make a digital examination of the rectum. This fulfils the double purpose of revealing any obstruction to the passage of the bougie and at the same time lubricates the anal sphincter much better than the tube would do it. Because of the risk of syphilitic infection, always use a rubber finger-cot.

Fill the syringe with the warm water. Lubricate the bougie and insert the tip into the sphincter. By gentle pressure, pass it into the rectum about one-third of its length. Insert the syringe and inject the water very slowly through the bougie as it is pushed further up. The water disengages the tip of the bougie from folds or angles where it is apt to catch. If the bougie meets an obstruction, the free passage of the water through the bougie indicates that its tip is not obstructed but that the neck of the bougie is held in a constriction. On the other hand, if water cannot be injected while the bougie passes upward, it indicates that the tip is bent on itself against some obstruction or is buried in a fecal mass. In this case, do not push onward but withdraw the bougie a little and try again, injecting water as the bougie passes upward.

The utmost gentleness should be employed in passing the bougie. Serious injury to an inflamed or softened intestinal wall may be caused by rough usage.

In a normal rectum and sigmoid, a No. 8 bougie can be passed its entire length without pain. In sigmoiditis, its passage causes pain when it has been introduced about two-thirds of its length. Often there is an apparent constriction at this point which yields slowly to gentle pressure.

If No. 8 will not enter the sigmoid, try No. 6 or smaller. The diagnostic points of sigmoiditis are pain on entering the sigmoid, constriction at this point or the presence of mucus on the tip of the bougie when withdrawn. Do not confuse sigmoiditis with appendicitis or other suppurative processes in or near the pelvis. In these also the passage of the rectal bougie causes pain.

Treatment.

Spasmodic stricture here as elsewhere is best treated by gradual and very gentle dilatation. Begin with a small size that will enter the sigmoid easily. Treat every third or fifth day, holding the bougie in place for increasing lengths of time up to ten minutes and gradually increasing the size. With some patients having little pain or tenderness, a daily treatment can be given with advantage.

The cure of these cases is materially hastened by the injection of one of the following mixtures into the sigmoid. After the bougie is in place, inject one ounce of the solution. Then, while the patient or an assistant places the finger or a small piece of cotton over the external orifice of the bougie to prevent the escape of the medicine, draw about one ounce of water into the syringe and inject it in order to drive into the sigmoid the medicine that otherwise would remain in the bougie. The patient should lie quiet for ten minutes or longer.

Iodoform	1 dram	Fluid hydrastis	1 dram
Bismuth subnitrate	1 oz.	Warm water	1 oz.
Sweet almond oil	1 pint	Mix and inject	

Mix. Shake well and inject one ounce.

This preparation is known as fluid hydrastis. It is not the fluid extract.

THIOSINAMINE AND SODIUM SALICYLATE.

(Fibrolysin)

For dissolving scar tissue.

Thiosinamine (allyl sulphocarbamide or allyl sulphourea) is an allyl compound of sulphur and urea, derived from oil of mustard. It has remarkable dissolving power on newly-formed cicatricial tissue of all kinds. With sodium salicylate, it forms a double compound that is more soluble and less irritating than thiosinamine itself. The compound is sold under the trade name of fibrolysin.

Thiosinamine and fibrolysin are reported to have caused the disappearance of newly-formed fibrous tissue in all parts of the body, as follows:

Stricture of the œsophagus	Scars following burns or operations
Stricture of the urethra	Scleroderma and keloid
Stricture of the rectum	Scars of acne or other pustules
Palliative in cancer stricture	Corneal scars
Glandular tumors	Pleural adhesions
Elephantiasis	Peritoneal adhesions
Delayed resolution in pneumonia	Perigastric adhesions
Dupuytren's contraction	Pelvic adhesions
Fibrous ankylosis	Chronic otitis media

Benefit has been claimed in such apparently incurable lesions as the scleroses of locomotor ataxia and of optic neuritis.

Not all these enthusiastic claims are realized in practice but there is no doubt that the drug has a solvent power on newly-formed fibrous tissue. The author has seen instances of benefit and cure in many of the lesions mentioned. It is worth a trial in all of them. In treating strictures and stiffened joints, dilatation and manipulation will assist the cure.

The drugs have been given by the mouth, two or three grains daily, but their action is much more prompt and certain when injected intramuscularly every second or third day deep into the gluteus maximus. The author's practice is to alternate the intramuscular injection with an injection close to the lesion, beneath a scar, directly into an ankylosed joint and as close as possible to adhesions. The injection is practically harmless. Out of many thousand injections, one case of purpura hæmorrhagica has been reported as probably due to the drug. With tubercular cases, caution may be necessary, the drug dissolving the fibrous encapsulation of old lesions.

In private practice, the injection is conveniently given in the form of fibrolysin, glass ampoules each corresponding to about three grains of thiosinamine, sterilized ready for use. The ampoule, the syringe and the needle should be warmed in hot water and the injection given warm to prevent the liquid crystallizing in the needle.

Where economy is an object, the solution may be extemporized by dissolving 24 grains of thiosinamine and 12 grains of sodium salicylate in one-half ounce of hot water in a sterilized bottle with sterilized cork. Tie in the cork and sterilize again in steam or boiling water for ten minutes. Inject 20 to 30 drops, corresponding to 2 and 3 grains thiosinamine. The solution is unstable and must be protected from light and air. It is fit for use as long as it remains clear but it is better made fresh every few days.

TEST DIET FOR DIABETES.

STRICT DIET TO RENDER THE URINE FREE FROM GLUCOSE.

This strict diet is not intended for continued use. It should never be carried on for more than a week or two without close supervision.

BREAKFAST.

Use no sugar, flour, bread or cracker crumbs in cooking. Sweeten with glycerin or saccharin. Thicken with cream.

3 eggs with fat bacon or 6 oz. ham, or 6 oz. fat mutton or pork chop or beefsteak or cold meat.

Eggs in any form.

6 oz. fresh or smoked mackerel, salmon or bluefish, halibut, smelts or any fish.

1 cup coffee or tea with two tablespoonfuls of cream, sweetened with glycerin or ¼ grain saccharin.

2 to 4 oz. cream diluted with 3 to 5 parts water.

LUNCH.

Use no sugar, flour, bread or cracker crumbs in cooking. Sweeten with glycerin or saccharin. Thicken with cream.

Clams. Oysters. Oyster cocktail.

6 oz. hot or cold meat, tongue, broiled kidneys, smoked or fresh fish, fowl, game, crabs, shrimps, scallops, broiled live lobster with melted butter, corned beef.

Or 3 scrambled or poached eggs (no toast) or omelet, ham omelet, Spanish omelet, cheese or tomato omelet.

Lettuce with egg, shrimp, lobster, sardine or chicken salad with mayonnaise.

2 to 4 oz. cream diluted with 3 to 5 parts of water.

DINNER.

Use no sugar, flour, bread or cracker crumbs in cooking. Sweeten with glycerin or saccharin. Thicken with cream.

Clams. Oysters. Oyster cocktail.

8 oz. (one plate) clear meat soup or broth with green vegetables or eggs. (No flour or potato). Clam broth.

8 oz. roast, boiled or broiled meat, fish, birds or game with meat gravy (no flour) or melted butter.

Vegetables:

Spinach	Sour pickles	Celery	Beet tops (but not beets)
Radishes	Vegetable marrow	Mushrooms	Watercress
Sauerkraut	Asparagus	Young string beans	Parsley
Onions	Artichokes	Brussels sprouts	Dandelion
Cauliflower	Kohlrabi	Cucumbers	Truffles

Relish:

Salt	Horse-radish	Olives
Pepper	Tomato ketchup	Salted almonds
Mustard	Pickles	Caviar
Vinegar	Chow chow	Worcestershire
Lemon juice	Paprika	Gherkins

Rhubarb, cranberries or unripe gooseberries, prepared with saccharin instead of sugar.

Salad:

Lettuce with egg, cucumber, tomato, celery, onions or watercress.

Chicken, crab, lobster, sardine or shrimp salad. Romaine, Escarol.

Dessert:

3 oz. cream cheese, Neufchatel, Camembert, Münster or Swiss cheese.
Lemon jelly or wine jelly with cream, sweetened with saccharin.
Sugar-free custard.
Sugar-free ice cream, sweetened with saccharin, any flavor.
Any dessert made of gelatin, eggs, cream, almonds or lemon, sweetened with saccharin instead of sugar.
Walnuts, hickory nuts, hazel nuts, almonds, peanuts, brazil nuts, a small handful.

LATE SUPPER.

If desired, any foods in foregoing table.

DRINK.

All natural or artificial mineral waters as Vichy, Seltzer, Apollinaris, White Rock, Poland, Highland water.

Lemonade, plain or seltzer, sweetened with glycerin or saccharin.
Tea and coffee, with cream but no sugar; ¼ grain saccharin; or 1 oz. diabetic cocoa.
Wines: Light Rhine or Moselle, Bordeaux, Burgundy, sugar-free diabetic champagne.
The mixture of cream and water is better than milk. One-half pint of cream daily.

CARBOYDRATE EQUIVALENTS FOR MILD CASES OF DIABETES.

The tolerance of the diabetic patient for white bread being known, he may substitute at pleasure, the following quantities of foods for each ounce of white bread allowed.

Bread: Rye, Graham, corn, oat, pumpernickle, 1 oz.
Zwiebach (without sugar), 1 oz.
Aleuronat bread, 2 oz.
Gluten and soya bread, usually same as Graham bread.
Triscuit or shredded wheat, 1 oz.

Cereals: Oatmeal, cream of wheat, farina, cornmeal, ¾ oz.
Rice, tapioca, sago, barley, ¾ oz.
Corn-starch, vermicelli, macaroni, ¾ oz.

Vegetables: Winter potatoes, 3 oz. New potatoes, 4 oz.
Turnips and carrots, 6 oz.
Sweet potatoes, beets, green peas, 4 oz.
Peas, beans, lentils, dried, 1 oz.

Fresh fruit: Apples, pears, peaches, plums, prunes, prunelles, green gages, grapes, melons, pineapples, mulberries, apricots, 6 oz.
Oranges (peeled), grapefruit, cherries, currants, watermelon, 12 oz.
Strawberries, raspberries, blackberries, huckleberries, 12 oz.
Bananas (peeled), nectarines, 3 oz.

Nuts: Chestnuts, 3 oz.

Sweets: Cane sugar, brown sugar, rock candy, ¾ oz. Fruit sugar, milk sugar, honey, ⅞ oz.
Raisins or dried dates, ⅞ oz. Preserved fruits, ¾ oz. Fruit jams, 1 oz.

Drinks: Milk, 1 pint. Cocoa or chocolate (without sugar), 2 oz. Beer, 1 pint. Sweet wines, 4 oz.

CASE RECORDS.

There is a radical difference between examining a patient for the purpose of selecting a homœopathic remedy and examining him for diagnosis. In taking the symptoms for prescription, the patient should tell his story and describe his symptoms in his own words without prompting from the physician.

In taking the history for diagnosis, follow Leube's advice and ask the patient a definite list of questions arranged to bring out information quickly and concisely. Unusual cases will require special elaboration of the scheme.

The following scheme has been in daily use by the author for many years.

CASE HISTORY.

Date	Age	Occupation	Residence

Present illness	Present weight
Chief symptoms	Heaviest
	Usual
Beginning	
Apparent cause	
Succession of symptoms	

Personal history
Diseases — Tobacco
Accidents — Alcohol
Operations
Family history — Brothers
Father — Sisters
Mother — Children

SYMPTOMS:

Headache
Vertigo — Memory — Sight — Hearing — Throat
Chest, Cough — Expectoration — Pain
Dyspnœa — Heart palpitation — Pain
Abdomen, Appetite — Thirst — After eating
Nausea — Vomiting — Eructation
Abdominal pain — Distension
Stools — Urination
Menstruation — Rheumatism
Back — Arms — Legs
Sleep — Wakes tired, rested
General strength — Spirits — S. power

Physical Examination.

Skin Eyes
Tongue
Throat Thyroid gland
Pulse Tension Respiration Temp. at m.
Heart, apex in space in. to left. Palpation Inspection
Areas, superficial Deep
Auscultation at apex
at base
in neck
Right lung, percussion
Auscultation
Resp. mobility Apex in.
Left lung, percussion
Auscultation
Resp. mobility Apex in.
Abdomen Ascites
Liver Genitals
Gall bladder Rectum

Appendix
Right kidney
Left kidney
Spleen
Stomach

Pelvis
Spine
Arms and legs
Lymphatic glands

Nervous system   Tremor   Paralysis   Rigidity   Coma   Convulsions
  Reflexes, pupil   Romberg   Patella   Ankle clonus
  Abdominal   Cremaster   Babinski

Urine 10   Alb.   Sugar   Diazo   Acetone
  Microscopical

Blood at   .m Hb.   Red   Leuc.   Pn.   Sl.   Ll.   Eos.
  Widal   Malarial plasmodia

Sputum

Test breakfast, Free HCl.   Total acid.   Lactic   Starch
  Pepsin   Chymosin   Blood

DIAGNOSIS

PROGNOSIS

TREATMENT

STOCKING THE LABORATORY

Required for Examining Urine and Gastric Contents

In 4 oz. Bottles

Acetic acid, U. S. P.,
Sat. sol. sodium chlorid,
Esbach's solution,
Purdy copper solution,
Liquor potassae,
Gram iodin solution,
Nitric acid, c. p.,
Hydrochloric acid, c. p.,
Sodium hydrate, sat. sol.,
Normal sodium hydrate,
Decinormal sodium hydrate,
Plumbic acetate solution,
Sulphanilic acid mixture,
Ether,
Chloroform,
Alcohol,
Hydrogen dioxid,
Obermeyer reagent.

In 1 oz. Dropping Bottles

Sol. ferric chlorid, 10%,
Sol. dimethylamidoazobenzol, ½%
Sol. phenolphthalein, 1%
Sol. sodium nitrite, 0.5%.

In 1 oz. Bottles

Bromine,
Powdered guaiac,
Vanillin,
Phloroglucin,
Egg albumen discs,

Fresh yeast.

Order Chemicals in the Following Quantities. Cost about, $8.00

1 lb. acetic acid, 36% U. S. P.,
1 lb. nitric acid, c. p.,
1 lb. hydrochloric acid, c. p.,
1 lb. aqua ammoniae fortior,
1 lb. glycerin, c. p.,
1 lb. sodium chlorid, c. p.,
1 lb. alcohol, 95%,
1 lb. ether, washed,
1 lb. chloroform, pure,
½ lb. hydrogen dioxid,
½ lb. potassium hydroxid, sticks,
½ lb. sodium hydroxid, sticks,
½ lb. bromin,
4 oz. plumbic acetate, c. p.
4 oz. citric acid, c. p., for Esbach,
4 oz. picric acid, c. p.,
1 oz. ferric chlorid,
1 oz. iodin crystals,
1 oz. potassium iodid, c. p.,
1 oz. powdered guaiac,
1 oz. cupric sulphate, c. p.,
1 oz. sulphanilic acid,
1 oz. sodium nitrite, c. p.,
½ oz. phenolphthalein,
½ oz. dimethylamidoazobenzol,
½ oz. vanillin,
¼ oz. phloroglucin.

Apparatus for Urine and Gastric Contents, Cost $18.

Bunsen burner,
1 dozen test tubes, ½ x 6 inches,
Litmus paper, red and blue,
Test tube rack,
Urinometer,
Esbach albumin tube,
4 dropping bottles, 1 oz.,
18 reagent bottles, 4 oz.,
Stomach tube, see page 58.

1 small distilling flask,
2 Einhorn fermentation tubes,
Doremus ureometer with foot,
6 beakers, 5 oz.,
2 porcelain dishes,
Strauss' separating funnel,
1 package 3-inch filter papers,
50 c. c. graduate,
50 c. c. burette and holder.

For Examination of Blood, Sputum and Smears, Add the Following:

Chemicals

4 oz. ligroin or xylol,
1 oz. anilin oil,
1 oz. carbolic acid, c. p.,
1 lb. antiformin,

Grübler's Dyes

10 gme. methyl violet,
10 gme. methylene blue,
10 gme. fuchsin.

Blood Stains

Jenner,
Giemsa,
If desired,
Leishman, Wright, Hastings or Goldhorn.
Manson's borax blue,
India or China Ink.

Apparatus for Blood, Sputum and Smears. Cost, $16.00.

Haemoglobinometer,
Haemocytometer,
  Red cell diluting tube,
  Leucocyte diluting tube,
  Counting chamber,
Rubber suction ball.

1 gross slides,
1 oz. cover-glasses, ⅞ in. square,
2 clips for holding slides,
2 platinum loops,
Wire gauze, 4 inches square,

Microscope, Cost $75.00 and Upward

For Purdy Centrifugal Analysis. Cost, $1.25

1 oz. potassium ferrocyanide, c. p.,
1 oz. silver nitrate, c. p.,
1 oz. uranium nitrate, c. p.,
1 oz. barium chlorid, c. p.

Purdy Centrifuge and 4 Graduated Tubes. Cost, $40.00

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