was a slight polyuria. The urine was always clear and limpid, free from albumin and casts. Every specimen examined when centrifuged, presented from five to ten red blood cells in the microscopic field. Often they were difficult to discern. Evidences of pyelitis were not found in the urine at any time. Hematuria was never manifest to the naked eye.

Feeling nearly certain that the kidney harbored a stone, an x-ray picture was taken. Although it clearly revealed the kidney shadow, it showed no stone. An exploration of the kidney was nevertheless determined on.

OPERATION.—At Jewish Hospital, April 21, 1902. Oblique, lumbo-abdominal incision. When the deeper layers of the perirenal fat were reached, they were found much firmer than normal, and in exposing the capsule of the kidney firm adhesions to this of the fat layer had often to be divided with knife or scissors. The freeing of the kidney preliminary to incising it was as difficult as I have seen it after long-standing pyorenal fistulae. The kidney, of about normal size, was very grayish in color and much firmer to the touch than normal. A stone could not be felt. After placing an elastic ligature in the usual way about the pedicle, the kidney was freely incised in the line first described by Hyrtl, and the pelvis opened. Except for possibly a slight dilatation of the latter, nothing abnormal was found. To the naked eye the kidney section appeared normal, except for a grayish color which may have been due to the operative ischemia. A thin section was removed for microscopic study. The ureter was easily probed to the bladder and found normal. The operation was terminated as an aseptic nephrolithotomy. This was perhaps a technical error, for a slight infection occurred which delayed recovery. The suppuration was extrarenal. In the course of this, a thrombosis of the left femoral vein supervened. June 5 the patient was discharged from the hospital well, except for a slight swelling of the left foot, the last sequel of the femoral thrombosis. This also disappeared. Since his return from his vacation the patient has followed his affairs; has had no pain of any kind, and repeated examinations of the urine fail to show any trace of hematuria. November 1 the patient reports a gain in weight of twenty-four pounds since the operation.

PATHOLOGY.—The following is the report of Dr. Hiller on the findings: The examination of the thin slice of kidney substance removed *intra vitam* reveals changes in the parenchymatous elements. Although the glomeruli have generally retained their normal appearance, here and there in areas the normal tinging is lost, and distinct atrophy with granular change has occurred. The cells lining the tubules show in these areas a granular change with desquamation, the lumen of the tubule being often occupied by a granular debris in which nuclei are absent. On looking at the apparently normal kidney structure in the slide, the quantity of red blood cells both in and outside of the blood vessels stand out in bold relief. There is not present any distinct overgrowth of connective tissue nor are there any bands passing from the capsula propria of the kidney. This structure, although it does not appear thickened, seems unusually dense toward the outside.

In April, 1903, the patient reported from the Nile that he was in perfect health.

REMARKS.

The case presented is evidently one of atypical chronic inflammation of the kidney. In patches there was a distinct glomerulonephritis. From the adherence of the capsule proper to the fat capsule one might believe that a stone had existed at one time and was passed. The disappearance of the microscopic hematuria after the operation and the disappearance of all symptoms, and the fact that the patient never suffered from pain in the left kidney, make it reasonably certain that the disease in this case was unilateral.

Of considerable importance is the fact that a surgeon should not consider an operation on the kidney, in which he expects to find a stone negative in its results, when other changes in the kidney, as in the case reported,

cover to a nicety the symptoms of stone. The capsule splitting and the section of the kidney will doubtless relieve many cases which simulate stone, and in which, because of the impossibility to make a positive diagnosis, are not now subjected to an exploratory operation.

In conclusion, the author would advise that in every case a small section of the kidney be removed for the purpose of microscopic examination. It is only in such a way that minute changes of the kidney can be discerned, changes which, although seemingly slight, are often capable of producing, as in the case reported, the severest symptoms.

ACUTE SUPPURATIVE CERVICAL ADENITIS OF INFANCY.*

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The condition to which I would direct your attention within the brief limits of this paper is by no means rare to those who have considerable clinical experience among children, and deserves to be qualified by the words "of infancy" inasmuch as the great majority of the cases occur in children under 2 years of age. At this period of life the lymphatic system is especially vulnerable and the lymph nodes in the cervical region particularly liable to infection and suppuration.

While in a few of the cases met, the infection of the gland has been preceded by and is traceable to some infected cutaneous lesion, in the vast majority of the most typical cases it seems evident that they are dependent on absorption from the nasopharyngeal space. The degree of inflammation in the nasopharynx seems to bear but little relation to the occurrence of the glandular swelling, many young children suffering from acute coryza or pharyngitis of considerable severity with slight or no enlargement of the cervical glands, while in others, presenting the type under consideration, it is rather the rule than otherwise that there is little or no nasal involvement at the time of the attack, although careful inquiry may elicit the history of an almost forgotten coryza a week or ten days previously. We are therefore led to infer that pathogenic germs have been carried to the glands and have there remained quiescent, or that areas persist in the nasopharynx from which by absorption a sudden glandular inflammation of considerable intensity may be lighted up.

It may be well for greater clearness to state that while those infectious diseases of childhood and the exanthemata which affect the mucosa of the nose and throat may often be accompanied by swellings of the cervical glands or even by suppuration, these are not at present under consideration, nor do they present the characteristic type and course of the acute cervical adenitis of infancy.

The usual history of the latter is that either with or without a known antecedent attack of influenza or coryza there is the sudden appearance of a marked swelling below the angle of the jaw, which, on examination, proves to be due to palpable enlargements of a lymph gland or glands lying somewhat deeply and obliquely from behind downwards and forwards just below the angle of the jaw and either chiefly anterior to or posterior to the sterno-cleido-mastoid muscle. The variation in the

* Read at the Fifty-fourth Annual Session of the American Medical Association, in the Section on Diseases of Children, and approved for publication by the Executive Committee: Drs. H. M. McClanahan, A. C. Cotton and H. E. Tuley.

antero-posterior position of the mass appears to be due to the fact that there are two glands lying on about the same horizontal plane, one or both of which may be involved. The anterior one of these is easily palpated, the posterior one, which causes the swelling behind the sterno-cleido-mastoid, less easily, probably owing to its deeper position. Usually the chief incidence of the inflammation falls on but one of the glands, and the position of that one which is most enlarged determines the location of the mass. Holt in his text-book pictures the tumor as usually posterior. I have found it with about equal frequency anteriorly, and I present for your inspection two photographs of the same child in which evacuation and partial healing of the anterior gland was followed by typical involvement and suppuration posteriorly, which definitely confirmed my opinion that one or both of two glands might be involved.

Despite these variations, however, the general appearance and situation of the swelling is so characteristic that the diagnosis can usually be made by inspection. The child's head is thrown towards the opposite shoulder and the usual hollow beneath the angle of the jaw is replaced by a prominent mass, one and a half to two inches long by an inch or more in depth. Fever is usually present, 101 to 103 degrees, with malaise and irritability, and the mass is more or less tender to the touch. Where resolution takes place the gland remains about the same size for some days, firm and easily movable, and then decreases in size more or less rapidly. If suppuration is to occur the definite outline of the gland is lost after some days in a brawny infiltration of the surrounding tissues and with considerable uniformity fluctuation is followed by pointing at about the end of the second week.

The careful clinical observer will not confuse this condition with the less definite external swelling caused by the dissection outwards of a post-pharyngeal abscess, which, if it have reached that degree, already gives its own characteristic clinical symptoms; nor with mumps, the swelling due to which surrounds the lobe of the ear and in young children extends but a short distance below the lobe—in fact, terminates at about the point at which the mass of an acute adenitis begins. The fact that tuberculous adenitis rarely occurs before the beginning of the fourth year, and that the progress of such glandular enlargement and suppuration is rather a matter of months than of days, should, but unfortunately does not always, prevent the mistaken diagnosis of that variety of infection.

To the parent any affection of the infant which calls for surgical interference with the knife is a source of anxiety and mental suffering, while cicatrices on visible portions of the body, such as the neck, are an especial source of regret. When suppuration has occurred with beginning fluctuation it is an important rule in the management of these cases to delay incision until the thoroughly softened mass points with redness, enabling us to choose for our incision a location where the skin only need be cut through to reach the purulent accumulation. This is occasionally considerably delayed, especially in deep-seated accumulations posterior to the sterno-cleido-mastoid muscle, but in the few cases where an earlier incision has been made without distinct pointing it has been evident that the glandular tissue had not fully broken down, and discharge from the abscess cavity was prolonged and healing was tediously protracted.

The general surgical rule to lay open freely any pus cavity for the purpose of securing adequate drainage has a notable exception in these cases of acute adenitis of

infancy. Here the smallest incision which will allow of the evacuation of the pus and the introduction of the smallest obtainable drainage tubing is sufficient. If the mass is properly softened, as shown by pointing, the distended cavity contracts and granulation goes on with almost marvelous rapidity, granulations often pushing their way into the fenestræ of the tubing as early as the third day. Packing with gauze or the use of drainage wicks I have long since abandoned in favor of the tube, for the former is unnecessary, and both packing and wick become dry and adherent at the orifice, defeating our purpose by occlusion, favoring accumulation of pus and delaying restitution.

Since scars on the neck are to be regretted, especially in female infants, considerable attention has been given to securing the best cosmetic results by placing the smallest possible incision where it will be least noticeable. This is attained by placing the child in a bright light and seeking on or near the distended area of pointing for one of the delicate lines which mark what were the bottoms of the natural folds of the skin of the normal neck. On this line or, if it can not be traced over the mass, on a direct extension of this line, an incision is made without anesthesia but one-fourth of an inch in length. Evacuation of the pus is then favored by very gentle pressure and the occasional introduction of a grooved director or small dressing forceps until the cavity is entirely emptied. After slight stretching of the orifice with the dressing forceps a fenestrated tube three-sixteenths of an inch in diameter and one and one-fourth to one and a half inches long is introduced on a probe or small director to prevent doubling so as to reach the deepest portion of the cavity. This is secured externally with an 00 safety-pin, beneath which a fold or two of the dry dressing is, of course, placed to prevent uncomfortable pressure. On the second day usually the length of the tube is reduced one-half. On the third or fourth day there is but little discharge on the dressing and the tube may be removed. Thereafter there is a little thin mucoid discharge for a few days, and at the end of about eight days the wound is healed, leaving a minute scar at the bottom of a natural fold.

Where, after the removal of the tube, there is considerable induration of the tissues, the application of a 10 per cent. ichthyol ointment favors absorption and is more comfortable for the child than the dry dressing which becomes rough and hard with the drying discharge. When two adjacent glands have been involved and but one suppurated, induration is slow in disappearing. Rarely, as in the case of which I have shown you photographs, the adjacent gland suppurates later. If softening occurs rapidly we may occasionally reach the new cavity through the unhealed incision, but this is not often feasible. I have seen one case where it opened spontaneously on the seventh day into the unclosed sinus. Bilateral adenitis is not uncommon, but if one side suppurates the other usually resolves. My records, however, show cases where the other side suppurated from twenty days to six months later. Suppurative otitis media on the same side is a common sequela.

While strongly urging delay in incising until the appearance of localized pointing, this delay should not be prolonged until the skin is badly undermined, for in such neglected cases brought late to the surgeon healing is slow and unsatisfactory. This recommendation also should in no wise be construed to apply to the deep brawny phlegmon of the neck occurring in the course of scarlet fever where early incision is urgently indicated to prevent destruction of tissue if not of life.

Not all cases, however, of acute adenitis of infancy go on to suppuration. Holt states that in his experience of 109 cases, of which 96 were cervical, 62 per cent. suppurated. In my earlier experience with these cases certainly the majority of the glands broke down, but since the employment of the early and energetic abortive treatment, to be detailed below, suppuration has been the exception. Some years ago attempts to discover a successful abortive treatment were begun. Ichthyol ointment in various strengths was usually unavailing. Painting with iodine gave no better results. The continuous use of the cervical ice bag was ineffective. The various proprietary preparations of glycerin, kaolin and antiseptics in a mass of putty-like consistency, were faithfully tried, and only served to hasten suppuration like a poultice, for which purpose I now occasionally use them when abortive measures are clearly useless in the later stages. Absorption through the skin was evidently not sufficient in this region to affect the deep-lying glands.

The connection between chronic or subacute enlargement of the lymph nodes at the angle of the jaw and catarrhal conditions in the nasopharynx dependent on the presence of adenoid masses was then brought to my notice by the writing of Dr. Joseph Huber. The nasopharynx, owing perhaps to its situation and construction, has been accorded rather more than the usual neglect shown cavities whose interiors do not lend themselves easily to direct inspection. It seems to be only of comparatively recent date, despite the intimate connection between the condition of the mucosa of the nasopharynx and the integrity of the eustachian tube and the middle ear, that treatment of inflammations of the respiratory tract has been directed with any degree of regularity to this most resistant seat of catarrhal trouble, which, especially if adenoid masses are present with their deep sulci, affords an ideal opportunity for the retention and absorption of septic material. It is to Jacobi and Caillé that we owe, in this country most especially, the earnest recommendation of the nasal and post-nasal toilet for children, but only in the infectious diseases has this teaching taken root in general practice.

The connection between inflammatory conditions of the nasopharyngeal space and acute infections of the glands at the angle of the jaw once in mind it seemed probable that if promptly after the lighting up of the primary inflammation of the gland as evidenced by its enlargement, further absorption of infectious matter from the nasopharynx could be prevented, the gland might be able to cope successfully with the initial invasion and resolution occur, but that if fresh invasions were allowed to take place resistance would be overcome and the gland would break down. Attention was therefore at once directed to the problem of limiting septic absorption from the nasopharynx by measures which would keep the mucous membrane clean and also restore it as soon as possible to a normal condition. The plan adopted was as follows: When fever was present tablets were given containing:

R. Tinct. aconiti	
Tinct. belladon., āā.....m. 1/4	016
Camphorgr. 1/10	006

Sig.: One-half to one tablet, according to age, every two hours.

Chlorate of potash has an almost specific action in limiting the pharyngeal inflammations of childhood, therefore:

R. Potassi chloratis.....gr. i to ii	06-12
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Sig.: Every 2 hours for 24 hours, then every 3 hours, and later every 4 hours.

To cleanse and soothe the naso-pharynx:

R. Tablets alkaline antiseptic (Seiler).

Sig.: Dissolve one in half glass water and pour a little with a teaspoon into each nostril every 3 hours.

The results obtained from the institution of this line of treatment were immediately most gratifying and a period of over one year during which these abortive measures were successful in producing resolution in every case would have been made rather too favorable a report to be credited. I have therefore withheld it until the series has been broken by a few failures (four in number) which under careful observation have in themselves proved most instructive.

A comparison of the series of cases, both without and with abortive treatment, shows in the latter a very marked reduction in the frequency of suppuration. In children over one year of age among whom under old method pus formation occurred frequently, there have been no failures. In infants under 1 year there have been but four failures, at 4, 5, 7 and 10 months of age respectively, in each of these temperature persisted and reached an average of 101 to 102 degrees each day.

1. The conclusions to be drawn from my experience are that: The abortive treatment of acute cervical adenitis of infancy as outlined is most promising, especially in children over 1 year of age.

2. The younger the infant the greater is the liability to suppuration.

3. A continuation of temperature makes the occurrence of suppuration probable.

807 Madison avenue.

DISCUSSION.

DR. A. C. COTTON, Chicago—I believe it is my duty to go on record as approving this paper in the main. There is nothing especially new in the idea of the nasopharyngeal treatment of such cases, yet it is a matter of common observation that it is very rarely carried out. I think most practitioners of to-day will approve of a careful, judicious antiseptic cleansing of the nasal and post-nasal cavities. To be sure, there have been some objections on account of the possibility of forcing fluid, or rather infection, into the eustachian tube. With perhaps this single objection, I presume no one would differ from the essayist in regard to the importance of this nasopharyngeal and oral toilet. The determination of how much we believe in a thing may be best arrived at by observing our actions in regard to it. The Wisest Teacher said: "By their fruits ye shall know them." I recall a friendly review of a little publication that I brought out a few years ago, in which the book was treated in a most flattering manner, but the review closed with this statement: "The author's west side babies must be more tractable than those of the north and south sides, if they will permit the use of the tooth brush and atomizer advocated in this treatise." It was my privilege a year later to show the reviewer some families in which the daily systematic use of the tooth-brush, atomizer or nebulizer was as much a part of the toilet as the daily bath. The difficulties which to some physicians seem to be obstacles to the daily cleansing of the nasopharyngeal area are really insignificant. One father exclaimed: "Would you have me hold the child morning and evening while the mother and aunt perpetrate this cruelty?" It is needless to say that it had been improperly done. A little reflection will tell you that it is a simple matter if you approach the child on his weak side, and tell him he may have an atomizer for himself, such as papa and mamma have, provided he is specially good. You may use alcohol at first; then some favorite perfume or flavoring, and finally you can use some disinfectant agent. Let me say that in the families in which I have succeeded in installing this nasal toilet during the past five years there has not been one case of suppurative adenitis. I think that prophylaxis lies along this line.

DR. CHARLES GILMORE KERLEY, New York City—I agree with Dr. Southworth regarding most of the statements made.

It is only necessary to make use of a small opening. Unless some means of drainage is employed, this small incision is very apt to close in twenty-four or forty-eight hours, and will then require reopening.

The point of differentiation between tubercular adenitis and simple acute adenitis might perhaps have been brought out more clearly. I understood the author to say that tubercular adenitis was not frequently found under the fourth year. I should modify this statement somewhat. I have seen quite a few cases of tubercular adenitis in children under four years of age; hence, this is not a sufficient ground for differentiation. I should lay stress on chronicity. In acute adenitis there is always more or less fever, and the swelling is more rapid, and one, two or perhaps three glands are involved; in other words, there is a distinct localization, whereas if the process is tubercular there is much more apt to be a distinct chain of affected glands extending sometimes down even to the clavicle.

The treatment of the nasopharynx is excellent. I am glad to hear chlorate of potash advocated, for I know of no better remedy for internal use. I have learned, in cases of acute tonsillar inflammation, to depend on chlorate of potash, and I believe that whatever good the old iron and chlorate of potash mixture did in diphtheria is to be attributed to the chlorate of potash it contained. The chance of infection of the eustachian tube in nasal cleansing I believe to be considerable, and I do not allow my students to make use of any force. The patient is placed on the back and the fluid is dropped in, or perhaps an atomizer is used. There can be no doubt that bacteria may be forced into the tube by the use of the syringe. Four or five years ago, in one of the hospitals for infectious diseases in New York City, nasal irrigation was used very extensively by means of the fountain syringe, and during this period the aurist was kept very busy treating disease of the ear. This only confirms my own experience. I prefer simple oil or albolene medicated as the case may require, and this should be sprayed or instilled and not injected into the nose. With regard to the abortive treatment, I have had good results from the application of a small ice bag kept constantly on the parts.

DR. R. B. GILBERT, Louisville, Ky.—It is probable that the majority of cases of cervical adenitis do not come from the nasopharynx; most of the cases I see are the result of injuries and abrasions about the scalp. This is especially true in connection with invasion of the superficial glands, as from eczema. We often meet with cervical adenitis arising from caries of the teeth. I agree with the essayist, however, regarding the value of stimulating and cleansing applications to the nasopharynx. This should certainly be the routine measure. I can not quite agree with all that has been said regarding local applications, for I believe that fewer local applications, with possibly the exception of the ice bag, the better. Warm applications and ointments I think should be excluded. Iodid of potassium used internally certainly favors absorption, and I believe when administered every three hours in the full doses for the age of the patient, will accomplish more than any of the local applications mentioned, even more than the stimulating applications referred to. This treatment should be begun and carried out as promptly as possible in order to preclude surgical operation and unsightly scars.

DR. EVERETT J. BROWN, Decatur, Ill.—The reintroduction of chlorate of potash to the therapeutics of disease is to me very instructive. When I studied medicine the teachers warned us against the use of this drug, claiming that it produced profound anemia. My father, being an old practitioner, used to employ the old iron and chlorate of potash mixture, but I avoided it for the reason just mentioned. The patients, however, began to ask me why I did not prescribe the old mixture. I then began using it without the iron and I found that it was very valuable. In recent years chlorate of potash has been used very freely again, and has been recommended in very large doses in habitual abortion. For this class of cases I am now using it in divided doses of two and a half drams per day.

DR. C. F. WAHRER, Fort Madison, Iowa—We have been told formerly by the best authorities that chlorate of potash caused a great deal of disturbance of the kidneys in young children.

I believe we should not turn lightly from one position to the other in a Section like this, because its published opinions carry great weight. We can not afford to use forcible irrigations, and particularly with a substance like hydrogen dioxide. I have seen this substance employed in half strength in a child's nostril. The explosion of such a substance may do a great deal of harm by its action on the eustachian tube and middle ear, forcing infections beyond our control. The cleansing by such an agent should certainly be done only by instillation. The older practitioners looked on these cases of cervical adenitis as one of the evidences of scrofula, and while I am not quite sure what is meant by scrofula at the present time, I am of the opinion that it is generally tuberculous. However, we must be still careful about heroic medication with chlorate of potash and in the use of forcible irrigations in patients of tender age.

DR. WILLIAM CARVER WILLIAMS, Chicago—Has the author of the paper had any experience with mixed infection in these glandular cases? I recently had a case of typical adenitis, such as he described, which was treated by the small incision at the stage of pointing. It refused to heal and there was considerable discharge at first. In time the whole chain became indurated, and exhibited the evidence of tubercular inflammation, and these glands eventually required removal by operation.

DR. JAMES G. MASTIN, Chicago—I have been in the habit of using chlorate of potash internally in suppurative conditions and locally in sore throat. I believe this remedy will limit the formation of pus in a suppurative adenitis, and that if it is begun early enough we can almost wholly prevent the formation of abscesses. I think that chlorate of potash may be given without fear if the kidneys are in a healthy state. The use of irrigations by means of the fountain syringe, etc., and atomizers I look on as bad practice because it involves more or less force in the application of the remedy. For the past year I have been using Pattison's nasal irrigator, with which we can apply as much or as little force as we like. By applying the irrigator to one nostril a thin stream of water will flow out of the opposite nostril and by closing it with the fingers and holding the mouth open a thin stream of water will pass through the nasopharynx and out of the mouth, thus closing the nasal cavities and post-nasal space. I have not recently made use of albolene or other oily preparations, for, although they are good, I believe that normal salt solution is superior to them all.

DR. H. N. LEAVELL, Louisville, Ky.—With regard to tonsillar involvement: Very often, if we will pull back the anterior pillar of the fauces, we shall find a little crypt full of cheesy matter which has not been sufficient to cause an acute tonsillitis but has produced enough irritation to involve the lymph channels. This, it appears to me, is an etiologic factor of some importance. With regard to the abortive treatment of these cases of cervical adenitis, I may say that I employed such methods very faithfully some years ago in the hope of avoiding suppuration, but like Dr. Southworth, I failed, and I believe there is not much gained by local applications to these glands. He is certainly reaching the cause of the trouble with his cleansing applications to the nasopharynx, but we must not lose sight of the fact that the eustachian tube is present in this region and is much more pervious than in the adult, so that the infectious material is more likely to be transmitted to the internal ear. This emphasizes the need of great caution against the employment of force. I agree with the last speaker regarding the use of saline solution. I believe it is better for cleansing purposes than anything else, and that it hastens resolution of the inflammatory process in the nasopharynx. It might be advisable to follow it up with the use of albolene sprays.

DR. A. C. COTTON—I wish to explain what I have said. I did not refer to treatment but to the prophylaxis of cervical adenitis when speaking of the toilet of the nasopharynx. The albolene atomizer to which I had reference was the one which nebulizes the albolene, and it is deposited like a fog on the parts. Absolutely no force is used in the application, and the albolene goes wherever the air current goes. This oily ma-

terial protects against crusts and the concealment of colonies of bacteria.

DR. T. S. SOUTHWORTH—I spoke in my paper about the employment of the spoon because it can be used without any force. The nose and throat specialists say a great deal about the danger of applications which we make to children's noses and throats, and yet they are in many cases employing compressed air sprays. I am of the opinion that if fluids are simply allowed to percolate through the nose and cleanse the mucous membrane, unless the nose is forcibly blown at this time no harm will result. It is the extension of the inflammation along the tube which I believe causes most of the trouble.

With regard to differential diagnosis of tubercular and ordinary cervical adenitis I would say that tubercular adenitis rarely occurs before the fourth year. While this is not an absolute point of differentiation it is, I think, a useful one. I am glad to hear that there is such a general use of chlorate of potash for pharyngeal and nasopharyngeal affections. I have always felt some anxiety with regard to the use of this remedy, although I prize it very highly. I have used it always very cautiously, yet it was only last summer that I learned from a medical friend of a fatal acute nephritis with hematuria in a girl of 17 from the use of chlorate of potash. The girl had purchased the tablets for a cold, and had eaten them very freely, with the result stated. Such cases should at least make us very cautious. The cases in which iodid of potassium proves serviceable in my experience are chiefly those in which there is a persistent induration, or in cases having a specific taint. I have not found it of so much service in acute cases. I have not made use of the chlorate of potash locally. It is quite possible that some of the cases which are very persistent are those in which there is a specific element, or perhaps a mixed infection. Here also the use of chlorate of potash has seemed to be of advantage.

THE ESTIMATION OF UREA BY MERCURIC NITRATE.

J. H. LONG.

CHICAGO.

Since the original publications of Liebig on the use of a solution of mercuric nitrate in the urea estimation several attempts have been made to so modify the process as to render it more perfectly accurate for the purpose. Liebig himself recognized the variable character of the precipitate formed when a solution of mercuric nitrate is added to one of urea, even when the latter has a mean concentration of 2 gm. to 100 c.c. and the mercuric solution is dilute, with 1 c.c. about equivalent to 10 mg. of urea.

This irregularity depends in part on the liberation of free nitric acid in the operation, and Rautenberg and others¹ attempted to correct for this by the gradual addition of alkali in the form of calcium carbonate. In this paper the authors recommend to correct the direct result of the titration by subtracting 0.06 c.c. of mercury solution for each cubic centimeter below 30 employed in titration of 15 c.c. of the prepared urine (that is 10 c.c. of urine and 5 c.c. of the usual baryta mixture). For example, if, in a given titration, 22 c.c. were used the correction to be subtracted from 22 c.c. is $8 \times 0.06 = 0.48$, leaving practically 21.5 c.c. to be used in the calculation.

Pfeiffer² later confirmed the value of the Rautenberg method as against the criticisms of Pflüger and others. Pflüger³ published an elaborate investigation of the whole question and proposed a more delicate correction as well as certain definite methods in performing the

operations of the test. His work is the basis of the processes described in many of our text-books.

Gradually, however, it began to be recognized that the mercury solution combines with several substances besides urea, and that it measures really, in a certain sense, the total nitrogen of the urine. This fact, coupled with the somewhat complicated procedure and corrections of Pflüger, led finally to the practical abandonment of this simple method in favor of others which are apparently more accurate. The various hypobromite processes can not, of course, be included here; their use is limited to the roughest kind of clinical applications. But I refer to the methods described by Pflüger and his followers on the one hand, and by Mörner and Sjöqvist on the other, for the separation of the disturbing factors from the urea before the actual test is made. A study of the literature, however, reveals the fact that in all of these methods and their modifications corrections are still necessary, and that, in general, they are not suitable for use when a rapid and fairly accurate process is required in making routine tests in urine investigations where the other important constituents are measured at the same time.

It is unquestionably true that in the mercury titration process the chief source of error is found in the volumes of solution required by the chlorids, the ammonia and the creatinin. The correction for the first may be easily made after the chlorin titration, and in fresh urine an approximate correction may be introduced for the ammonia and the creatinin, if they are not accurately determined. In a former investigation⁴ I have made a large number of ammonia, creatinin and uric acid determinations and have found the correction to be introduced in the urea estimation on account of the presence of these. The mean value of the corrections are seen from these figures:

6 mg. of ammonia in 20 c.c. require 1 c.c. of mercury sol.

7.5 mg. of uric acid in 20 c.c. require 0.15 c.c. of mercury sol.

14.0 mg. of creatinin in 20 c.c. require 0.85 c.c. of mercury sol.

The 20 c.c. in each case is supposed to be made up of 10 c.c. of urine and 10 c.c. of water or baryta solution. In employing the process at all, or in the determination of ammonia, it is necessary to keep in mind that only fresh urine can be used with accuracy, because of the fact that in decomposition urea yields ammonia.

The apparently complicated corrections in the process as recommended by Pflüger are an objection to its practical use. I have, therefore, sought to simplify the procedure and corrections as far as possible, which may be accomplished in this way: First, the mercury solution is made in the usual manner and so adjusted that 20 c.c. correspond exactly to 200 mg. of urea in 20 c.c. when the end reaction is found as follows: Spread a number of drops of normal sodium carbonate solution (53 gm. Na_2CO_3 to the liter) on a glass plate with dark background, and as the end of the titration is neared bring a drop of the mixture in the beaker alongside one of the carbonate drops and cause the two to mix on one edge. Part of the beaker drop is thus drawn over the carbonate, giving a precipitate; as soon as this appears distinctly yellow consider the process finished and dilute the mercury solution so that exactly 20 c.c. should be required to produce this reaction, it being assumed that the standard solution in the beaker contained exactly 200 mg. of urea in 20 c.c. If a paste of sodium bicarbonate and water is used for the end reaction, or if the colored precipitate is

1. *Zeitschr. analyt. Chemie*, 2, p. 90, 1863.

2. *Ibid.*, 24, p. 475, 1885.

3. *Ibid.*, 19, p. 375, 1880.

4. *Jour. Am. Chem. Soc.*, 23, p. 632, 1901.