open up the wounds for the purpose of taking out loose fragments of bone. In a number of instances there was distinct guttering of the compact substance of long bones without fracture. The mobility in some instances was so slight that it was difficult to make out a complete fracture when from the location of the wounds it was certain that the bone had been traversed.

(6) "Beyond the zone of explosive effects the projectiles of hard exterior almost invariably perforate or gutter the joint ends of bones, and the lesions of the articulations are never so grave." This conclusion tallies exactly with what we saw in Cuba. I do not recall a formal excision of a joint for the mechanical effects of the Mauser bullet. Joints were opened to turn out blood clots, and in one instance of the knee I particularly remember, to locate a lodged ball, but never for the purpose of performing an excision. There were at least 20 cases of gunshot injury of the knee-joint alone. These were immobilized and shipped North; and as far as I have been able to ascertain they have done well. These results are a great contrast to those inflicted by the larger leaden bullet, which by its highly destructive effects must have caused a number of resections and amputations.

(7) "The projectiles of hard exterior lodge less frequently in the tissues than the old leaden bullet." The experience at Santiago among the wounded of both sides has shown a surprisingly large number of lodged balls. Although I am not prepared to state that the small-calibre bullet lodges as often as the old discarded leaden bullet, the frequency with which it did lodge was remarked upon by military surgeons generally. Dr. W. E. Parker, of New Orleans, an acting assistant surgeon in the base hospital, visited the Spanish hospitals in Santiago after the surrender, and in conversation with the Spanish surgeons he learned that our Krag-Jorgensen bullet had not lodged in their wounded as often as their Mauser bullet had lodged in our men. The explanation for this would seem simple enough. It should be remembered that we were on the aggressive in a region that was practically unknown to our troops, whilst the Spaniards were perfectly familiar with every foot of ground over which we must make the advance. As trained soldiers their officers had carefully studied the range at every point. With this valuable information in their favor they were in a position to commence an effective fire at remote ranges, say at 2,000 yards and more. We could not locate them as soon as they located us, and when we did locate them we had to study the range before we could commence an effective fire. It was while we were locating them and studying the range and gradually advancing that they placed so many balls into our soldiers. When we did commence an effective fire we had reached a point where the remaining velocity of our bullet on impact was sufficient to carry it through the body. There is another explanation which may be gathered from the difference in the energy of the two bullets at remote ranges. Our bullet being larger and heavier than the Mauser has greater energy at 2,000 yards and it will penetrate farther in the remote ranges than theirs. Again, ricochet shots, from the thick underbrush and broken ground, undoubtedly favored a certain percentage of lodgment. Many of the officers attributed the lodgment of projectiles to the use of defective ammunition used by the enemy. This point was so susceptible of proof that I instituted experiments to show the

relative penetration of the Mauser and Krag-Jorgensen rifles. The tests were made in large blocks of well-seasoned yellow pine fired into, across the grain, three feet from the muzzle. The penetration of the Krag-Jorgensen ammunition was 24 inches plus, whilst that of the Mauser ammunition exceeded ours by nearly 10 inches, a demonstration which at once set at rest the idea of lodgment from the defective ammunition of the enemy.

(8) "The old leaden bullet more often leaves fragments of lead in the foyer of fracture." This is so true that it needs no contradiction. The leaden bullet was so soft that it often separated into a number of fragments upon striking resistant bone, whilst the steel-jacketed bullet seldom encounters resistance enough in the human body to disintegrate it.

(9) "As the projectiles of smaller calibre are less apt to lodge or to carry foreign substances into the wounds we will expect to find fewer cases of suffering due to the remote effects of unextracted foreign bodies." This is true of the smaller bullet, as shown in Cuba. There were but few instances where clothing or part of the equipment was carried into the wound.

(10) "The frontage of the jacketed bullet being much less and the fact that it does not lodge as often as the larger leaden bullet will contribute to increase the percentage of recoveries in gunshot wounds of the lungs." That was especially true of the wounded in Cuba. As a rule the wounds of the lungs were apparently so trivial that it was difficult to restrain the men in a recumbent posture.

(11) "Owing to diminished frontage the new bullet will cause less disfigurements in wounds of the face." That is especially true of three officers who received painful wounds of the face. Two of them had never been accused of being possessed of good looks, and strange to say, since their mishap they are much better looking than they were before. On cosmetic grounds the new bullet has some recommendations.

(12) "The projectiles of hard exterior are more humane than the old, resections and amputations will not be so often required hereafter, soldiers will be more often restored to the State useful members of the community instead of cripples and pensioners, and in point of economy, the new projectile confers a great advantage." This last conclusion is also in accordance with the experience in Cuba. There were but three primary amputations and not one of them was done for injury by the small bullet. They were all the result of shell injuries. From the foregoing I believe we should conclude that the work of the experimenters agrees with the conditions found in war, and that their work was not done in vain.

OTITIS MEDIA IN ALL GRAVE DISEASES OF INFANCY.¹

BY E. H. POMEROY, M.D.,
Chief of Staff, Calumet and Hecla Mining Co.'s Medical and Surgical Service, Calumet, Mich.

I HAVE been forcibly impressed with the statement so frequently made in journals and addresses of late that pediatrics is the specialty of the general practitioner. Probably the overwhelming majority of calls to attend to children will be on account of gastro-

¹ Read at the fifth annual meeting of the Upper Peninsula Medical Society, held at Calumet, Mich., July 6, 1899.

enteric disturbances ; but only secondarily at this time is it my intention to bring gastro-enteritis to the attention of this meeting. My idea is that most of the diseases of infancy are more positively, more comprehensibly, more demonstrably infectious from definite bacterial infection than we can easily prove in adults, or if toxemia from bacterial growth, also more definite ; and that the pharyngeal postnasal chamber is the more easily comprehensible distributing point for infection to the middle ear, the brain, the lung, the stomach, the intestines ; and the middle ear an incubator and generator promoting general toxic disturbance in very many cases of localized infectious diseases.

P ONFICK'S TABLE OF ONE HUNDRED CONSECUTIVE AUTOPSIES OF INFANTS, THE FIGURES REFERRING TO OTITIS MEDIA.

	Normal.	Unilateral.	Bilateral.	Normal.	Unilateral.	Bilateral.
NON-INFECTIOUS PROCESSES.						
1. Congenital heart disease	1		1			
2. Extensive burns			1			
3. Non-infectious dermatitis		1	2	1	1	4
INFECTIOUS PROCESSES.						
A. Acute.						
1. Infectious dermatitis	1		3	1		3
2. Diphtheria	3	1	2			
3. Scarlatina			1	3	1	3
4. Pneumonia	1		10			
5. Meningitis (with or without pneumonia)	1		8	1		18
6. Gastro-enteritis, acute	1	2	5			
7. Gastro-enteritis, chronic (with or without pneumonia).	1	5	21	2	7	26
8. Otitis media only		2	6			
9. Otitis media with acute bronchitis			2		2	8
B. Chronic.						
10. Chronic tuberculosis only		1	3			
Chronic tuberculosis with acute generalization (acute miliary tuberculosis)	1	1	10	1	2	13
11. Congenital syphilis			3			3
	9	13	78	9	13	78

There have been a great many contributions to the subject of otology in young children during the past two or three years especially. Probably the one writer whose contributions have attracted the greatest attention and discussion is Ponfick, of Breslau. His principal article on this subject is entitled "The General Pathological Significance of Middle-Ear Diseases in Infancy." It was an address delivered at the Silesian Congress for Natural Culture in June, 1897, and published in the *Berliner klinische Wochenschrift* during the months of September and October following. Ponfick's attention to the subject was drawn by his personal observation of his own children, who had been dangerously ill with gastro-enteritis. The symptoms became alarming in spite of the most careful attention of himself and colleagues and increasingly so until the sudden amelioration, which was simultaneous with a discharge from the ear. The improvement in the gastro-enteric condition continued until there was a cessation of the discharge from the ear, then came a relapse of the gastro-enteric symptoms, very gradual and apparently in connection with some change or faulty preparation of the food. The change for the worse was so gradual and so naturally ascribed to the

faulty food that the discharge from the ear was well-nigh forgotten, until it recurred and with it again a pronounced and sudden amelioration of the gastro-enteric symptoms. This happened not only with one child but with two or three in the same family. It impressed Ponfick so much that he, with his associates, observed carefully the condition of the ear in the first subsequent 100 autopsies of children under three years of age. The results of these post-mortems are embodied in what will now be designated Ponfick's table, which contains some most astonishing presentations of facts concerning not only gastro-enteritis but many other conditions in infantile mortality.

These 100 autopsies he has divided under two heads : Non-infectious diseases, and those from infectious processes, and subdividing these into groups according to the disease. In most of these cases the actual condition, or rather the condition of the middle ear, preceding death was not suspected, and the cause of death is given by the attending physician who had charge of the case at the time of the child's death. In only a few of these cases is the history of the case during life obtained. Among the non-infectious group is found a heterogeneous collection, two of congenital heart disease, one of extensive burns, and three of non-infectious dermatitis. Of these only one was found free of otitis. This was a five-and-one-half-months-old infant with a congenital heart disease. Although this would appear to have the least possible connection with otitis, yet the only other case of congenital heart disease in this group was a one-year-old child showing otitis media in both ears and both drums filled with pus.

In Rotch's "Pediatrics" we read that von Trötsch found on examining 47 petrous bones taken from unselected children that the middle ear was normal in only 18. The other 29 ears showed in varying degrees purulent and sometimes mucous catarrh. Of 15 children with exudation in the middle ear, the youngest was three days and the oldest one year old ; five were in their first month, two each in their second and fourth, and the others in their third, seventh, eighth and twelfth month. In every five examinations of the ears of new-born children Schwartze found the tympanum filled with pus in two. Wreden found in 80 ears of children a normal middle ear in only 14. I refer to this here as showing the necessity of examining the ear in all cases of grave disease in very young infants and not confining our attention to an examination in the exanthemata. Referring again to Ponfick's table, we find that the other three dying from non-infectious or traumatic skin disease, and during life wholly without suspicion of otitis, were found to be all cases of otitis and, with one exception, bilateral.

The second group or category, those of infectious processes, embraces 94 per cent. of all the cases collected ; and this list is subdivided into (a) acute and (b) chronic ; sub-group (a) including all excepting the 16 cases of chronic tuberculosis and the three of congenital syphilis.

In Sub-group 1, of infectious dermatitis, such as erysipelas and furunculosis, there was not one free of otitis, and three of the four were otitis media purulenta bilateralis. In this connection Dr. Edward H. Clarke's statement, which has been largely quoted by other writers on otology, must be referred to. His statement is that the physician who neglects the examination of the ear in the course of the exanthemata of

children should be denominated an unscrupulous practitioner.

In Group 2 of our table are six cases of diphtheria with three absolutely free of otitis. This must be considered either accidental or very astonishing, as diphtheria has been and naturally would be held from its nature and the localization of its symptoms as directly conducive to otitis. To me, however, this showing is comprehensible when we remember the acuteness with which diphtheria manifests its localized symptoms in the throat. I mean by this that the local inflammation is so early and so intense near the pharyngeal end of the Eustachian tube that the Eustachian orifice is closed in many cases before the germs gain entrance into the tympanic cavity.

In Group 3 the one case of scarlatina gave otitis media on both sides. In Group 4, among the 11 cases of uncomplicated pneumonia there was only one, a six-months-old child, in which otitis was absent. In the other 10 cases, ranging in age from two to fifteen months, all showed otitis and in every case purulent and bilateral.

Groups 6 and 7: In these groups there was the greatest difficulty of classification, on account of the tendency to designate differently among different physicians the cause of death in cases where there is a complication of pulmonic and enteric disease. In these two groups as designated, however, we find the great proportion of 35 per cent. of all cases tabulated in this paper. All cases of gastro-enteritis are designated as acute up to the fourteenth day; all in which the duration is beyond that time, as chronic. In the eight cases of acute gastro-enteritis only one was found free of otitis, two were unilateral and five bilateral.

In the chronic enteritis (where the symptoms had persisted more than fourteen days), complicated or not with pneumonia or severe respiratory disease, there were 26 cases and only one of these proved to be free of otitis. Another interesting feature connected with the autopsies of this group was that where the complicating pneumonia was considered most positively the cause of death, the autopsies showed an unexpectedly severe condition of the gastro-intestinal inflammation or a surprisingly slight disease of the lungs, but with one exception all showed otitis media and 21 of the 26 showed this otitis to be bilateral and purulent. In the eight cases where the cause of death was given as uncomplicated otitis media the diagnosis was confirmed by the autopsy. The same was the case in those complicated with acute bronchitis. In only one of the 16 cases of tuberculosis, a ten-months-old boy, was otitis absent. In the other 15 cases there was otitis, some purely mucous and some purulent. In two cases, a two-months-old boy and a boy three and one-half years of age, the otitis was upon one side only. In the other 13, ranging in age from four months to three years, it was upon both sides.

The two subdivisions of Group 10 include chronic pulmonary tuberculosis, four cases, and 12 cases of chronic tuberculosis with acute generalization (acute miliary tuberculosis). The three cases of congenital syphilis were all under four months of age, and the cause of death in each case was considered to be a low constitutional vitality without any special symptomatology beyond this; but in all three of these the otitis was upon both sides and purulent.

In the face of these facts it seems to me we cannot conscientiously attend any grave disease in children

without the most careful examination as to the condition of the ear. This is troublesome under the circumstances of light and diet, and ignorance and carelessness, and well-known faultiness of food. It is troublesome to make these examinations, and except as a preparation for better work in the future, it will be for us useless to make them if we do not know enough to recognize disease of the ear drum when the membrane is unruptured; but by conscientious exercise of the technique, one with eyes to see can become expert. In the light of the information presented in this table of Ponfick's, otitis media exists in such an astounding proportion of children's diseases that it is our duty to learn to make these examinations. It is as much our duty to examine the drum membrane as it is our duty to examine a rash upon the skin. Physicians from the time of Hippocrates have looked at people's tongues and learned next to nothing by doing so; and we can certainly learn to look at the tympanic membrane when we have ground for such a hope of saving great numbers of lives.

And now in accepting the responsibility, the unpleasantness, and the discomfort of habitual examinations of the infantile ear in almost every infantile disease, we do not have to be guided by whim or blind empiricism, for we can easily bring to our support substantial, sound, scientific theory, if not absolute conviction. The middle ear is a chamber of most delicate construction, with numerous recesses, processes and angles, lined with the most delicate and absorbent of tissues, its walls rich in a network of nerves, blood-vessels and lymph channels, more intimately connected with the central nervous system than any other extracranial portion of the body, and in easily comprehensible connection with the gastro-intestinal and respiratory systems. It is easy for us to understand how this chamber can become infected through the Eustachian tube, easy to understand how, once infected, an inflammation can be excited which will close this Eustachian tube. The infection once established, this chamber is readily turned into an incubator for bacterial growth and a generator for the production of bacterial toxins. The natural process of infant feeding, especially the most natural, the mother's breast feeding, the sucking, causes the greatest possible tendency to the paroxysmal opening of the Eustachian tube, through which bacteria may be expelled into the postnasopharyngeal space and with the next breath to be taken into the lungs or with the next swallow to be taken into the stomach. The middle ear being affected and the exit being prohibited or impeded, we have the production of bacterial toxins in a place where they can be readily absorbed into the general circulation, a general toxemia be produced, influencing any concurrent or accidental ailment in any other portion of the infant's body. This all seems to me so reasonable, so absolutely incontrovertible, and so substantiated by actual facts, that I insist it is our duty as general practitioners, as specialists in pediatrics, to give this matter our daily and most conscientious attention. I will cite but a few cases to show the varied conditions in which we in Calumet have found these observations to be worthy of the trouble of making, but I would assure you that in no case have we regretted the time or the trouble given to them.

These cases are selected on account of the varying conditions. The number can doubtless be multiplied in the practice of any busy general practitioner.

CASE I. A. K., male, age five months. First day: Temperature, 99.8°; pulse, 100. Frequent vomiting; watery diarrhea which had been gradually increasing for past two weeks. Baby bottle-fed from six weeks of age. Condition apparently not grave and ascribed to faulty preparation of food and irregular feeding. Treatment principally correction of diet. Second day: Condition unchanged. No apparent tenderness about the ears, but careful examination of the tympana not made. Further effort made to correct errors in diet. Colon irrigated with water at 70°; bismuth every hour. Third day: Convulsions and death. During life no examination of the tympana of this child was made and the general appearance of the child had not been such as to excite any grave apprehensions. After death, with my associate, Dr. A. B. Mills, I examined the ears. The left tympanum was found tense, and on puncturing clear fluid was liberated. The right tympanum was tense and bulging, and on puncture thick pus poured out. The impression this post-mortem examination made upon my mind was that if these ears had been punctured a day earlier the child would have recovered promptly.

CASE II. G. M., male, age nine weeks, was brought to the Calumet Hospital with history of having been crying continually for fifteen days excepting only when drugged with gin or soothing syrup. Temperature normal, pulse almost imperceptible, bowels constipated. The ears were examined by five physicians, including myself, and we were unable to discover any abnormality in color of the drum membrane, and a bulging in the left tympanum was so slight as to leave doubt of the tympanum being distended with any fluid. Puncture, however, was made, three or four drops of pus liberated, and a solution of cocaine ordered to be dropped into the ear. Before the cocaine solution, however, could be brought from an adjacent room the little patient fell into a peaceful sleep. His mother said it was the only natural appearing sleep he had had in fifteen days; that during these past fifteen days when he slept it was with his eyes and mouth open and his features so pinched and drawn that he looked worse than when he was crying. This sleep lasted over two hours, when he awoke, took the breast heartily, and then went to sleep again and did not awake for eight hours, and from that moment has been in perfect health.

CASE III. R. D., female, age seven weeks. Continuous vomiting for three days. Temperature 105°. Coughing and crying frequently, the cough always exciting crying. No tenderness on pressing the palm of the hand against the external ear. Owing to the smallness of the external auditory canal, examination exceedingly difficult. Puncture was made, however, and scarcely more than a drop of pus liberated from each tympanum. Twenty-four hours later the mother described the child as absolutely well, nursing and sleeping naturally. Temperature 98°.

CASE IV. In the service of my associate, Dr. W. K. West. L. T., male, age eighteen months. Bronchopneumonia with diarrhea for two weeks. This is the fourth attack this child has had. Had been weak and sickly most of the time since birth. There were no ear symptoms, but puncture of both membranes was made on account of the physical signs being not extensive enough to account for the evident gravity of the child's condition. Profuse discharge of pus resulted from one ear, a very slight discharge from the other. There was immediate relief to the restlessness and pain of the

child, within twenty-four hours complete convalescence was distinctly established; the cure was perfect, and there has been no outward symptom in the child's rapid development since that time, although this was nearly a year and half ago.

CASE V. M. H., female, age five weeks. Nursing. Apparently no pain, but profuse watery diarrhea and rapid emaciation from only three days' illness. Puncture of right tympanum liberated two or three drops of pus and immediate amelioration of the diarrhea followed, although no medicine whatever was given, and no change in diet.

It should be remembered that our earlier teaching has led us to neglect the ear except in cases presenting ear symptoms. Ponfick's presentation of the subject has demonstrated the absolute unreliability of this policy of waiting. While in his 100 cases it was shown that the ear drum had previously ruptured in eight cases, that is, eight ears, 91 per cent. of all the cases examined had shown middle-ear inflammation, and in only 14 of these was the inflammation limited to one ear, and in 77 cases the inflammation was bilateral, representing 154 tympana, making, in addition to the 14 others, 168; that is, spontaneous rupture had occurred in less than nine per cent. of all the cases of otitis. Presumably also nearly all of these cases excepting those in Groups 8 and 9 were without any symptoms of ear disease.

In regard to the technique of this examination, all I can say is that the utmost endeavor should be made to get the best possible light (an artificial light), with the head mirror and an assorted nest of specula, and that the ear of the infant, being different from that of the adult in the shape of the external auditory canal, should be drawn downward and outward instead of backward and upward, and if the external canal be obstructed by dirt, cerumen, or anything else, it should be carefully washed and the effort at examination resumed. Nothing but long-continued practice will suffice to give one a definite idea of the appearance of the tympanic membrane either in health or in disease, but the practice should be persisted in, for there is nothing about it to prevent any practitioner with eyes becoming as expert in this examination as the most cultured aurist. The fact should be reiterated again and again that in very many cases there is no abnormal appearance to the exterior of the tympanic membrane, and yet the middle ear may contain pus and be the source of a toxemia threatening the life of the patient. It is important also to remember that an incision made carefully in the lower posterior quadrant of the tympanic membrane is wholly free of danger and will frequently reveal a case of grave disease and at the same time be the means of almost instant relief. Thorough cleansing of the ear and douching it with sublimate solution should be done before the puncturing, and ether or chloroform anesthesia induced for a thorough examination.

Since reading this paper at the annual meeting of the Upper Peninsula Medical Society, I have read with much interest a valuable article in the *Philadelphia Medical Journal* of August 5, 1899, by Dr. J. S. Meltzer, of New York. It but adds to my conviction, which is more and more confirmed by my increasing experience in practice, that the proper application and appreciation of this contribution of Ponfick's will result in the saving of great numbers of lives and the amelioration of much suffering.