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TRANSACTIONS

OF THE

AMERICAN PEDIATRIC SOCIETY.

FIRST SESSION,

WASHINGTON, D. C., SEPTEMBER 20,

AND

BALTIMORE, MD., SEPTEMBER 21, 1889.

TOGETHER WITH THE

PROCEEDINGS OF THE MEETING FOR ORGANIZATION,

HELD IN

WASHINGTON, D. C., SEPTEMBER 18, 1888.

EDITED BY

WM. PERRY WATSON, A.M., M.D.,

RECORDER.

VOLUME I.

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1890.

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OFFICERS FOR THE YEAR 1888–89.

President.—A. Jacobi, M.D. . . . . New York.
First Vice-President.—A. V. Meigs, M.D. . . . . . . Philadelphia.
Second Vice-President.—F. Forchheimer, M.D. . . Cincinnati.
Secretary.—W. D. Booker, M.D. . . . . Baltimore.
Recorder.—Wm. Perry Watson, M.D. . . . . . . Jersey City.
Treasurer.—Chas. Warrington Earle, M.D. . . Chicago.

Council.—1888–89.

T. S. Latimer, M.D. . . . . Baltimore.
J. M. Keating, M.D. . . . . Philadelphia.
I. N. Love, M.D. . . . . St. Louis.
J. H. Ripley, M.D. . . . . New York.
S. C. Busey, M.D. . . . . Washington.
C. P. Putnam, M.D. . . . . Boston.
A. D. Blackader, M. D. . . . . Montreal, Canada.

Members.—1888–89.

Adams, S. S., M.D. . . . . Washington.
Baruch, S., M.D. . . . . New York.
Billington, C. E., M.D. . . . . New York.
Blackader, A. D., M.D. . . . . Montreal, Canada.
Booker, W. D., M.D. . . . . Baltimore.
Brown, Dillon, M.D. . . . . New York.
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Carr, W. L., M.D. . . . . New York.
Chapin, H. D., M.D. . . . . New York.
Dorning, John, M.D. . . . . New York.
Earle, Chas. Warrington, M.D. . . . . Chicago.
Edwards, W. A., M.D. . . . . Philadelphia.
Forchheimer, F., M.D. . . . . Cincinnati.
Fruitnight, J. H., M.D. . . . . New York.
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Meigs, A. V., M.D. . . . . Philadelphia.

Moore, C., M.D. . . . . London, Canada.
Northrup, W. P., M.D. . . . . New York.
O'Dwyer, Joseph, M.D. . . . . New York.
Osler, William, M.D. . . . . Philadelphia.
Pepper, William, M.D. . . . . Philadelphia.
Putnam, C. P., M.D. . . . . Boston.
Reid, John J., M.D. . . . . New York.
Ripley, J. H., M.D. . . . . New York.
Rotch, T. M., M.D. . . . . Boston.
Scharlau, B., M.D. . . . . New York.
Seibert, A., M.D. . . . . New York.
Smith, J. Lewis, M.D. . . . . New York.
Starr, Louis, M.D. . . . . Philadelphia.
Vaughan, V. C., M.D. . . . . Ann Arbor.
Watson, Wm. Perry, M.D. . . . . Jersey City.
Waxham, F. E., M.D. . . . . Chicago.
Wendt, E. C., M.D. . . . . New York.
Wilson, J. C., M.D. . . . . Philadelphia.
Winters, J. E., M.D. . . . . New York.

THE AMERICAN PEDIATRIC SOCIETY.

THE American Pediatric Society met for permanent organization in Washington, D. C., September 18, 1888, in a parlor at the Arlington Hotel. The first session commenced at 10 A.M. In the absence of the temporary chairman, Dr. J. Lewis Smith, of New York, the meeting was called to order by the temporary secretary, Dr. W. D. Booker, of Baltimore.

Dr. A. Jacobi, of New York, was elected temporary chairman, and Dr. W. D. Booker, of Baltimore, temporary secretary.

By request of the chairman the secretary gave a brief statement of the preliminary organization of the Society, as follows:

"After the adjournment of the Pediatric Section of the Ninth International Medical Congress, September 9, 1887, a meeting was held by a few of the members of the Section, and on motion of Dr. W. D. Booker, of Baltimore, seconded by Dr. I. N. Love, of St. Louis, it was decided to organize The American Pediatric Society. Dr. J. Lewis Smith, of New York, was elected temporary chairman, and Dr. W. D. Booker, of Baltimore, temporary secretary. The chairman was authorized to take such measures as he saw fit to secure the co-operation of some of those physicians who had taken a special interest in the advancement of the study of diseases in children, and, when advisable, to appoint five of these to act with the chairman and secretary as a council to arrange for the permanent organization of the secretary. Notices were sent to a limited number of physicians who had become known through their interest and work in promoting a more scientific study of diseases in children, asking for their views in regard to the propriety of establishing the Society, and inviting co-operation. The response to these invitations showed a general desire to organize the Society, and a hearty co-operation was promised. With this cordial approval of the movement it was decided to leave the permanent organization of the Society to be effected altogether by those participating in it, so that all could have an equal voice and responsibility in whatever measures were adopted. No further steps were taken in the matter except to send the announcement of this meeting to those who had accepted the invitation to participate in it."

The motion was then made by Dr. Watson to organize The American Pediatric Society, which was unanimously carried.

Drs. Jacobi, Booker, and Watson were appointed a committee to draft a constitution, and to report the same at 12 M., to which time the Society adjourned.

SECOND SESSION.

The Society was called to order at 12 M. by the temporary chairman, Dr. Jacobi. The committee reported the draft of a constitution (see page ix), which was unanimously adopted, after which the permanent officers (see page v) were elected.

Dr. Meigs moved that propositions for membership be considered in order during the present session of the Congress of American Physicians and Surgeons. Carried.

Dr. Latimer moved that each member be assessed five dollars, to be passed to the credit of dues for the ensuing year. Carried.

The Secretary read a communication from Dr. William Pepper, chairman of Executive Committee of the Congress of American Physicians and Surgeons, extending, in the name of that committee, a cordial invitation to the members of this Society to attend the sessions of the Congress. Also one from Dr. S. C. Busey, chairman of Committee of Arrangements, granting to the members of this Society the same privileges to the social entertainments as were enjoyed by the members of other special societies.

It was moved that this Society apply for admission to the Congress of American Physicians and Surgeons. Unanimously carried.

The secretary was instructed to present the application to the Executive Committee of the Congress.

Dr. A. Jacobi was elected delegate to the Congress.

The Society then adjourned to meet next year, the time and place to be decided upon hereafter.

CONSTITUTION AND BY-LAWS.

ARTICLE I.

OBJECTS OF THE SOCIETY, AND NAME.

The Society has for its object the advancement of the Physiology, Pathology, and Therapeutics of Infancy and Childhood. It shall be known as THE AMERICAN PEDIATRIC SOCIETY, and shall hold an annual meeting.

ARTICLE II.

PROCEEDINGS.

The proceedings shall consist of:

1. Discussions on subjects previously selected.
2. Original communications.
3. Demonstrations of gross and microscopic preparations, of apparatus and instruments.

ARTICLE III.

MEMBERS.

There shall be members and honorary members. The number of members shall be limited to one hundred. Physicians of sufficient eminence to merit the distinction may, to a number not exceeding twenty-five, be elected honorary members, and as such shall be entitled to attend all meetings and take part in the proceedings, but not to vote upon business questions.

ARTICLE IV.

ELECTION OF MEMBERS.

Nominations to membership shall be made at a regular meeting of the Society, and shall be referred to the Council, which shall report those nominations which are approved by it to the next annual meeting for action. A three-fourths vote shall be necessary for election of members, but for the election of honorary members a unanimous vote of those present shall be required.

ARTICLE V.

ANNUAL DUES.

Each member shall pay an annual fee of ten dollars. Honorary members shall be exempt from fees.

ARTICLE VI.

OFFICERS.

The officers shall consist of a President, two Vice-Presidents, a Secretary, a Recorder, a Treasurer,—all to be elected annually,—and a Council.

ARTICLE VII.

DUTIES OF OFFICERS.

The duties of the President, Vice-Presidents, Secretary, and Treasurer shall be those usual to these officers. The Recorder shall secure the papers read, and see that proper notes are taken of the discussions thereon, for the use of the Committee on Publication.

ARTICLE VIII.

COUNCIL.

The Council shall consist of seven members, who shall be chosen at the first meeting by ballot. One, selected by lot, shall retire at the end of the first year, and shall not be immediately eligible to re-election; another, similarly selected, shall retire at the end of each year, until all of those originally chosen shall be disposed of, after which one shall retire each year, in the order of election, and his place be supplied by another.

ARTICLE IX.

DUTIES OF COUNCIL.

It shall be the duty of the Council to suggest the subjects for discussion, to consider the nominations for membership, and to report on them at the meeting at which they shall be balloted on. The Council shall also be a Committee on Nominations to Office, and as such shall present a report at the morning session of the last day, at the conclusion of which session the election shall be held by ballot.

It shall appoint a Business Committee of three, who shall, with the President and Secretary, make all arrangements for the meeting, including the preparation of a programme.

ARTICLE X.

PUBLICATION COMMITTEE.

The Secretary, Treasurer, and Recorder shall constitute a Committee on Publication, to which shall be referred all papers, reports, and other matters intended for publication.

ARTICLE XI.

CHANGES IN CONSTITUTION AND BY-LAWS.

Proposals for changes in the Constitution and By-Laws must have been made at the meeting previous to that at which they are voted on, and the notices for which shall contain an announcement of the proposed changes; and such changes shall require, for their adoption, an affirmative vote of three-fourths of those present.

ARTICLE XII.

EXPULSION OF MEMBERS.

A member may be expelled from the Society for conduct unbecoming a physician and a gentleman. In such cases formal charges must be made by two members, which shall be referred to the Council. Membership shall lapse because of absence from three successive meetings without reason acceptable to the Council.

ARTICLE XIII.

QUORUM.

Any number of members present at the appointed time of the annual meeting shall constitute a quorum for the transaction of ordinary business; but for the election of members, fifteen shall be necessary for a quorum; and for the expulsion of members or for altering the Constitution and By-Laws, twenty-five members shall be necessary.

ARTICLE XIV.

ORDER OF BUSINESS.

1. The President shall call the meeting to order and open the session by an address. In his absence one of the Vice-Presidents shall preside, and in the absence of all these officers the Chairman of the Council.

2. The discussions shall be the next order of business, and shall be confined to the first morning session. The two members appointed to open the discussions shall, as a rule, not occupy more than twenty minutes each. Subsequent speakers shall be restricted to ten minutes each.

3. Voluntary papers shall not exceed twenty minutes in the reading. In the discussion following the reading of such papers, remarks shall be limited to ten minutes.

4. Demonstrations shall be provided for in the afternoon sessions.

5. Members chosen to discuss subjects previously selected must send an abstract of their report to the Council, for distribution to members previous to the meeting.

6. In the morning session of the last day, of which it shall be the first business, the report of the Council as a Committee on Nominations to Office and to Membership shall be made, and ballot shall be held thereon.

OFFICERS FOR THE YEAR 1889–90.

President.—J. Lewis Smith, M.D. . . . . New York.
First Vice-President.—A. V. Meigs, M.D. . . . . . . Philadelphia.
Second Vice-President.—F. Forchheimer, M.D. . . Cincinnati.
Secretary.—W. D. Booker, M.D. . . . . Baltimore.
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S. C. Busey, M.D. . . . . Washington.
C. P. Putnam, M.D. . . . . Boston.
A. D. Blackader, M.D. . . . . Montreal, Canada.
L. Emmett Holt, M.D. . . . . New York.

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Earle, Chas. Warrington, M.D. . . . . . Chicago.
Edwards, W. A., M.D. . . . . San Diego, Cal.
Forchheimer, F., M.D. . . . . Cincinnati.
Fruitnight, J. H., M.D. . . . . New York.
Haven, H. C., M.D. . . . . Boston.
Holt, L. Emmett, M.D. . . . . New York.
Huber, F., M.D. . . . . New York.
Jackson, Henry, M.D. . . . . Boston.
Jacobi, A., M.D. . . . . New York.
Jeffries, John A., M.D. . . . . Boston.
Keating, J. M., M.D. . . . . Philadelphia.
Koplik, H., M.D. . . . . New York.
Lafleur, H., M.D. . . . . Baltimore.
Latimer, T. S., M D. . . . . Baltimore.
Love, I. N., M.D. . . . . St. Louis.
Meigs, A. V., M.D. . . . . Philadelphia.

Moore, C., M.D.	London, Canada.
Northrup, W. P., M.D.	New York.
O'Dwyer, Joseph, M.D.	New York.
Osler, Wm., M.D.	Baltimore.
Pepper, William, M.D.	Philadelphia.
Putnam, C. P., M.D.	Boston.
Reid, John J., M.D.	New York.
Ripley, J. H., M.D.	New York.
Rotch, T. M., M.D.	Boston.
Scharlau, B., M.D.	New York.
Seibert, A., M.D.	New York.
Smith, J. Lewis, M.D.	New York.
Starr, Louis, M.D.	Philadelphia.
Townsend, Chas. W., M.D.	Boston.
Vaughan, V. C., M.D.	Ann Arbor.
Watson, Wm. Perry, M.D.	Jersey City.
Waxham, F. E., M.D.	Chicago.
Wendt, E. C., M.D.	New York.
Wilson, J. C., M.D.	Philadelphia.
Winters, J. E., M.D.	New York.

MINUTES

OF THE

FIRST ANNUAL MEETING

OF THE

AMERICAN PEDIATRIC SOCIETY,

HELD AT WASHINGTON, D. C., SEPTEMBER 20, AND BALTIMORE, MD., SEPTEMBER 21, 1889.

September 20, 1889.—*Morning Session.*

THE President, A. Jacobi, M.D., of New York, called the meeting to order at 10 o'clock, in the library of the Surgeon-General's office, Washington, D. C.

The following members were present:

S. S. Adams, Washington; W. D. Booker, Baltimore; Dillon Brown, New York; S. C. Busey, Washington; A. Caillé, W. L. Carr, New York; Charles Warrington Earle, Chicago; J. Henry Fruitnight, L. Emmett Holt, Francis Huber, A. Jacobi, New York; J. M. Keating, Philadelphia; Henry Koplik, New York; T. S. Latimer, Baltimore; A. V. Meigs, Philadelphia; W. P. Northrup, J. O'Dwyer, New York; William Osler, Baltimore; William Pepper, Philadelphia; C. P. Putnam, Boston; A. Seibert, New York; William Perry Watson, Jersey City; J. E. Winters, New York; and John A. Jeffries, Boston, and H. N. Vineberg, New York, by invitation.

Dr. A. Jacobi then delivered his annual address on "The Relations of Pediatrics to General Medicine."

The reports—verbal—of the Secretary and Treasurer were then made.

On motion, it was decided to hold a session this evening in a parlor of the Arlington Hotel.

On motion, it was decided to accept the invitation of the Superintendent of the Johns Hopkins Hospital to hold a regular session there to-morrow.

Dr. Francis Huber then read a paper on "Two Cases of Double Empyema," which was discussed by Drs. Caillé, Koplik, Pepper, Osler, Putnam, Carr, Holt, Fruitnight, Vineberg, and Meigs.

Dr. Charles Warrington Earle then read a paper on "Subcutaneous Emphysema in Children," which was discussed by Drs. Huber, Fruitnight, Jacobi, and Carr.

Dr. A. Caillé then read a "Report of a Case of Membranous Croup (laryngo-tracheitis) in a Girl Twelve Years Old: Tracheotomy: Recovery," which was discussed by Drs. Brown, O'Dwyer, and Jacobi.

Dr. Caillé also read a paper on "Personal Prophylaxis in Diphtheria," which was discussed by Drs. Fruitnight and Earle.

Dr. Charles Warrington Earle then read a paper on "The Necessity of Prolonged Rest after some Attacks of Diphtheria."

The Society then adjourned until 3 P.M.

Afternoon Session.

Society called to order by President Jacobi at 3 o'clock.

Dr. J. Henry Fruitnight then read a paper on "The Treatment of Scarlet Fever and its Complications."

Dr. L. Emmett Holt then made a report of "A Case of Congenital Malformation of the Heart, simulating Dextro-Cardia," with presentation of specimen, which was discussed by Dr. Northrup.

Dr. A. Caillé also presented a specimen, "Janiceps Asymmetros."

Dr. J. O'Dwyer then read a paper on "The Apparent Physical Contraindication involved in the Re-inflation of a Collapsed Lung while an Opening remains in the Pleural Sac," which was discussed by Drs. Northrup, Jacobi, Carr, and Jeffries.

Dr. Dillon Brown then read a paper on "Noisy Respiration," which was discussed by Drs. Fruitnight, Caillé, Huber, and Carr.

Dr. Henry Koplik then read a paper on "Tuberculosis of the Testis in Childhood."

Dr. Francis Huber then read a paper on "Acute Suppurative Peritonitis following Vulvo-Vaginal Catarrh," which was discussed by Drs. Caillé and Koplik.

Dr. W. P. Northrup then read a paper on "Sclerema Neonatorum : Report of a Case," which was discussed by Drs. Huber, Koplik, Holt, and Jacobi.

On motion, a vote of thanks was given to Dr. John S. Billings and the Surgeon-General U.S.A., for their kindness in providing a room for the meetings of the Society.

The Society then adjourned until 8 P.M.

Evening Session.

The Society was called to order at 8 o'clock by President Jacobi, in a parlor of the Arlington Hotel.

Dr. A. V. Meigs then read a paper on "The Artificial Feeding of Infants," which was discussed by Drs. Holt, Winters, Keating, Caillé, Booker, Adams, and Fruitnight.

Dr. John A. Jeffries then read a paper (by invitation) on "A Contribution to the Summer Diarrhœas of Infancy," which was discussed by Drs. Northrup and Booker.

Dr. J. O'Dwyer then read a paper on "A Case of Diaphragmatic Hernia, with Operation," which was discussed by Drs. Northrup, Holt, and Vineberg.

Dr. A. Caillé then read a paper on "Prolapsus Recti due to a Large Stone in the Bladder of a Girl Three Years Old," which was discussed by Dr. Fruitnight.

On motion, it was decided to go to Baltimore on the nine o'clock train to-morrow morning.

On motion, it was ordered that all the papers read, and the discussions thereon, be furnished to and published exclusively in the ARCHIVES OF PEDIATRICS, the publishers of which in return, to furnish the Society with five hundred reprint copies of the same.

On motion, a vote of thanks was extended to Dr. Jeffries for coming to the meeting and reading his valuable paper.

The resignation of Dr. Simon Baruch, of New York, was presented and accepted.

On motion, the Society adjourned until to-morrow morning.

September 21. — *Session held in Johns Hopkins Hospital, Baltimore, Md.*

The Society was called to order at 10.30 A.M. by President Jacobi.

Dr. H. N. Vineberg then read a paper (by invitation) on "Some Practical Points in the Diagnosis and Treatment of Malaria in Children," which was discussed by Drs. Earle, Holt, Fruitnight, Jeffries, Carr, Huber, Seibert, Jacobi, Keating, Watson, Caillé, and Latimer.

On report of the Council, the following officers were elected for the ensuing year:

President.—J. Lewis Smith, M.D., New York.

First Vice-President.—A. V. Meigs, M.D., Philadelphia.

Second Vice-President.—F. Forchheimer, M.D., Cincinnati.

Secretary.—W. D. Booker, M.D., Baltimore.

Recorder.—William Perry Watson, M.D., Jersey City.

Treasurer.—Charles Warrington Earle, M.D., Chicago.

COUNCIL.

T. S. Latimer, M.D., Baltimore; J. M. Keating, M.D., Philadelphia; I. N. Love, M.D., St. Louis; S. C. Busey, M.D., Washington; C. P. Putnam, M.D., Boston; A. D. Blackader, M.D., Montreal; L. Emmett Holt, M.D., New York.

On report of the Council, the following gentlemen were elected members of the Society:

John A. Jeffries, M.D., Boston; Henry Jackson, M.D., Boston; Charles W. Townsend, M.D., Boston; H. Lafleur, M.D., Baltimore.

The Council also recommended the following amendments to the Constitution: Article XIV., Section 3, "Should any paper be too long to be read in twenty minutes, the writer will be expected to prepare an abstract which can be read within that time." Article XIV., Section 5, to insert after the word Council, "six weeks before the annual meeting." Article X., insert at end, "All papers presented shall become the property of the Society."

Dr. Holt offered, as an amendment to Article V., the following: "Each member shall pay an annual fee, the amount of which shall be decided upon at each annual meeting."

The proposals for membership were referred to the Council.

Dr. T. S. Latimer then read a paper (with presentation of case) on "Cases of Spastic Paraplegia."

Dr. R. H. Thomas then presented, for Dr. Osler, specimens of Cerebral Sclerosis in children.

Dr. W. D. Booker then read a paper on "A Study of some of the Bacteria found in the Dejecta of Infants affected with Summer Diarrhœa." (Second communication.)

Dr. A. Seibert then read a paper on "Two Years of Experience in the Mechanical Treatment of Gastro-Intestinal Disorders in Infants," which was discussed by Drs. Koplik, Keating, Booker, Vineberg, and Jacobi.

The following papers were read by title and referred for publication: "Two Cases of Nystagmus associated with Choreic Movements of the Head in Rhachitic Babies," by A. Caillé, M.D.; "Aneurism in Early Life," by A. Jacobi, M.D.; "Carpopedal Contractions,—one Manifestation of Tetany," by Chas. Warrington Earle, M.D.; "Notes on a Case of Ataxia in a Child of Two Years," by A. D. Blackader, M.D.; "Two Cases of Biliary Cirrhosis in Children," by M. P. Hatfield, M.D.; "Recent Improvements in Infant Feeding," by J. Lewis Smith, M.D.

On motion, a vote of thanks was given to President Jacobi for his untiring efforts in behalf of the successful meeting now about to close.

President Jacobi presented the thanks of the Society to the authorities of Johns Hopkins Hospital for courtesies shown the Society.

On motion, the Society adjourned, subject to the call of the Council.

THE PRESIDENT'S ADDRESS.

THE RELATIONS OF PEDIATRICS TO GENERAL MEDICINE.

BY A. JACOBI, M.D.,
New York.

Gentlemen,—Progress and success, in order to be complete and unmistakable, require centralization of means and co-operation of men. The pioneer in his seclusion, the hard-working settlement, the thin population of a county, the joining of the disseminated parts to form a state, and the amalgamation resulting in the establishment of a powerful and world-moving nationality, exhibit an example of the geometrical increase of strength resulting from the combination of forces. The isolated labors of the greatest men in the history of science never accomplished anything beyond a spasmodic and stationary advance. Twenty centuries in succession lived on the unchanged teachings of Hippocrates, Aristotle, and Galen.

The establishment of institutions of learning in modern times, mainly since the fifteenth and sixteenth centuries, multiplied the names of men, though none reached those three ancients, who, in contact with others equally disposed, labored successfully in the interest of science. Paracelsus, Descartes, Sydenham, Boerhaave, Van Swieten, Haller, Peter Frank, and Bichat promoted science, partly through contest, partly through co-operation with fellow-laborers. The multiplication of institutions, the similarity of aims and ambitions, the establishment of faculties and learned societies, accomplished, through the co-operation and friction thus created, a progress more pronounced in decades than formerly in centuries.

The best results, however, were obtained by the voluntary associations of scientific men, all over the world. In this century, the German Association of Naturalists and Physicians, the British and the American Medical Associations, the numerous local and provincial societies, and last, though by far not least, the American Congress of Physicians and Surgeons, with its many special associations and societies, have not only encouraged scientific originality but raised the average standard of the profession at large.

That is what the isolated labors of individual men never attained. From this point of view I hailed the proposal to form an American Pediatric Society with satisfaction and delight. Thirty years ago I contemplated the formation of a section for the purpose of studying the diseases of children in the New York Academy of Medicine, and failed. These nine years the American Medical Association had its section on diseases of children, the first meeting of which took place under the presidency of S. C. Busey, and the New York Academy of Medicine has a flourishing pediatric section under J. L. Smith. To-day this national association has convened without difficulties and with all the promises of speedy success. The spontaneity of its origin is a guarantee of vitality and prosperity. My failure at that early time did not signify that no attention had been paid in the United States to the physiology and pathology of infancy and childhood. It simply meant that the relations of pediatrics to practice and to the other departments of medicine were not yet duly appreciated. In most countries in Europe it was the same. In America the names of Dewees, Stewart, Eberle, Condie, Charles D. Meigs, John Forsyth Meigs, and W. V. Keating are still holding an honorable place in the history of pediatrics. But their labors were individual and isolated. Though their teachings were appreciated, the profession at large was not sufficiently advanced to look upon the close and special study of the diseases of children as a necessity from the twofold point of view under which I began early to consider it. I was ever of opinion that not only had special occupation with infant pathology and therapeutics its reward in itself, but its connection with every other special doctrine aided and fostered the intimate and profound knowledge of other branches of medical science and art. Thus the future connection of this society with the Triennial Congress of American Physicians and Surgeons will prove a mutual benefit to all parties concerned.

In an introductory to the "Cyclopædia of the Diseases of Children," edited by John M. Keating, I have tried to establish the claims of pediatrics to be considered a specialty. Not that it is one in the common acceptation of the term. It does not deal with a special organ, but with the entire organism at the very period which presents the most interesting features to the student of biology and medicine. Infancy and childhood are the links between conception and death, between the fœtus and the adult. The latter has attained a certain degree of invariability. His physiological labor is reproduction; that of the young is both reproduction and growth. As the history of a people is not complete with the narration of its condition when established on a solid constitutional and economic basis, so is that of man, whether healthy or diseased, not limited to one period. Indeed, the most interesting time, and the one most difficult to understand, is that in which persistent development, increase, solidification, and improvement are taking place.

I have tried to prove that "pediatrics does not deal with miniature men and women, with reduced doses and the same class of diseases in smaller bodies, but that it has its own independent range and horizon, and gives as much to general medicine as it has received from it." My reasoning was that there is scarcely a tissue or an organ which behaves exactly alike in the different periods of life. I tried to prove that assertion by a cursory consideration of the osseous tissue, the nervous system, the digestive organs, and the blood and the system of circulation, and the requirements of general therapeutics in the young. To these expositions I added a few remarks on the peculiar character of the diseases of infancy and childhood. There are anomalies and diseases which are encountered in the infant and child only. There are those which are mostly found in children, or with a symptomatology and course peculiar to them; and those, finally, which affect both the young and old, with such varieties, however, both in symptoms and course, as depend on the size or nature of the inflicted organ or organism, or the difference in the degree of its irritability.

The relations of pediatrics to the several special parts of the extensive field of scientific medicine are very various. Internal medicine owes many of its best results to the observations made on infants and children. It is in them that constitutional and developmental diseases are either best or exclusively studied. In this connection I remind you only of scrofula, rhachitis, anæmia, and chlorosis. Infectious diseases, such as diphtheria, scarlatina, measles, varicella, parotitis, pertussis, and tuberculosis, mainly of the bones and joints, of the glands and peritoneum, are mostly encountered in infancy and childhood. Neoplasms are not only frequent in young children,—more than forty cases of sarcoma of the fœtal or infant kidney alone were collected by me for the International Congress of Copenhagen five years ago,—but rouse the most intense interest, from the fact that Cohnheim tried to trace every neoplasm of later life to its embryonic or fœtal origin. All the actual or alleged disorders belonging to dentition, most forms of stomatitis, amygdalitis, and pharyngitis, including latero- and retro-pharyngeal abscess, many of the most frequent and important diseases of the nose with their consequences, and of the larynx, are met with in the young. It is in them that catarrhal pneumonia has been studied principally, atelectasis almost exclusively. Some of the forms of diarrhœa, and still more of constipation, are exclusively the property of young children. It is in them, also, that internal medicine has learned the pathology of muscular pseudohypertrophy; from them, finally, that it has improved and increased diagnostic resources, for nobody can study Finlayson's contribution to the first volume of the Cyclopædia without finding many of them greatly depending on certain peculiarities of the several infant organs.

The surgery of infancy and childhood is so peculiar, its indications so varying, the number of cases so large, and some of the operative procedures so exclusively or almost exclusively adapted to, or necessitated by, surgical diseases of the young, that the transactions of surgical societies and journals are largely filled with discussions on subjects belonging to the sphere of pediatrics. I remind you of the frequent occurrence of congenital malformations requiring interference; those of the anus and rectum, hare-lip and fissured palate, spina bifida and hydrocephalus. The several forms of bone-disease, in the vertebræ, the hip- and ankle-joints, which require resection or scooping, demand special knowledge and skill, because of the dignity of the intermediate cartilage. Osteotomy is more frequently performed in the rickety young than at any other age or in any other disease. Tubercular swelling of the lymph-bodies occurs more frequently in the young than in advanced years. The majority of tenotomies are performed on children. Tracheotomy and intubation belong pre-eminently to early age. The largest number of tracheotomies performed by an individual operator is furnished by an author who does not claim any merit as a professional surgeon. The operation for pyothorax is mostly required in the young, and taxes the experience and prognostic judgment of the medical man to an unusual degree, because of the variety of indications depending upon the amount of flexibility of the ribs and the extent of complications. Invagination is mainly seen in the very young. Twenty-five per cent. of all the cases occur under one year; fifty-three under ten. Two-thirds of those under a year are between the fourth and sixth months. Perityphlitis, though rare in infants, is not at all infrequent in children of seven or eight years and upward; and both it and intussusception require often surgical interference. Indeed, so common are the claims on surgical skill in the practice among infants and children, that among the most instructive and interesting surgical treatises are those which discuss the surgery of childhood alone. I will only recall the special works of Guersant, Forster, Bryant, Giraldès, Holmes, St. Germain, and the fifteen hundred pages written by a dozen different authors in C. Gerhardt's "Manual of the Diseases of Children." It is a good move on the part of the editors of the new treatise of Henry Ashby and G. A. Wright that one of the authors is an experienced operative surgeon.

The connection of pediatrics with neurology is very intimate indeed. Many of the most interesting neuro-physiological data have been secured by our special colleagues. Thus, Soltmann's researches prove that in the new-born the inhibitory centres of the cerebral cortex are almost not formed at all, and that the motory and sensitive irritability increases rapidly about the fifth and sixth months. This is the time at which reflex excitability is very great. It has also been found that the inhibitory function of the cardiac nerves is but feeble in the very young. The contraction under the influence of the electrical current resembles very much that which is observed in the fatigued animal, and the peripherous nerves exhibit a slight excitability only. Many other observations can be made on the infant only,—thus, for instance, those concerning the first awakening of perception. On the first or second day of life hearing is active; sight sufficiently developed to be affected by light and darkness; taste and smell exist, but are feeble, and the sense of touch is mainly demonstrable on the lips. The perception of pain is but slightly developed.

Many such special contributions to the physiology of the nervous system gathered in the young could be introduced here. I can omit that in the presence of those who know; but refer to the special works of Kussmaul, G. Darwin, and Preyer, which treat of the psychology of the infant, and to the general treatises on the physiology of the young by Allex, Vierordt, and Victorio Massini.

Neuropathology also owes a great many results to the observations made on infants and children. Disorders of the nervous system are very common in the young. Of all the deaths resulting from diseases of the nervous system, eighty-seven per cent. take place during the first five years of life. Their frequency is best understood by the consideration of their many causes. Many are inherited or acquired during fœtal life. Others are due to the insufficiency of the protection afforded to the brain. Thus it is that any trauma, the pressure of a narrow pelvis or the forceps, a fall which in the very young produces rather a general disorder than a local lesion, leads to serious consequences. The neighboring organs, such as the ear or the scalp, are liable to affect the brain; for that reason otitis and impetigo are dangerous processes. The very anatomical development, the increasing separation of the two cerebral substances, and the incompetency of the centres of inhibition and those of co-ordination, lead to morbid processes. Anomalies of the bones, such as rhachitic softening and, still more, premature ossification, interfere with the cerebral development or lead directly to serious or incurable alterations. The incomplete structure of the blood-vessels is another frequent cause of disease from mere temporary congestion to serous effusions or to extravasations. Thus we have an explanation of many of the facts unaccountable to the superficial observer only. The number of neuropathies not directly fatal is excessive in the young. Convulsions of every description, eclampsia, chorea, tetany, epilepsy, poliomyelitis, Friedreich's ataxia, gather their most copious harvest among infants and children. And again, it is these on whom most of our knowledge of cerebro-spinal meningitis and cerebral meningitis has been obtained.

Neurology's sister, psychology, is indebted for much of its wealth to the study of the intellectual life of infancy and childhood. It is sufficient to refer again to the valuable and influential researches of Kussmaul, the younger Darwin, and W. Preyer. Psychiatry also has learned from the mental aberrations occurring at an early age, the more so as many of the causes of mental disease in later life must be traced back to embryological data and the morbid changes of infancy. Asphyxia of the newly-born, with its resulting effusion, extravasations, or thromboses, is a frequent cause of life-long epilepsy, stupidity, or idiocy. Diseases affecting the brain at an early period preclude the formation of ideas. The absence of inhibitory and psychomotor centres in the newly-born animal precludes the equilibrium required for a normal mental organization. The disposition to psychical disturbance resulting from individual constitution, the influences of heredity, and congenital neurasthenia can be studied at the very earliest age. The symptoms of fully-developed or imminent or future mental disease are more readily studied in the young than at more advanced age, for in the young the slightest deviations will tell. Such symptoms, which are easily recognized, are waywardness and restlessness, grimacing, convulsive twitching and convulsibility, abnormal sleep, retardation of growth, and excessive masturbation. Wherever they are found to be not the direct results of easily appreciated causes,—as, for instance, what I have called local chorea depending on chronic naso-pharyngeal catarrh,—psychical disturbances may well be feared. They are more frequent than the reports of lunatic asylums would appear to prove. For there are but few insane children in the institutions, for obvious reasons.

It is only those cases which become absolutely unmanageable at home which are intrusted to an asylum. Thus it is that we can obtain more accurate statistics of idiocy than of dementia of early years. The anatomical symptoms of degeneration, leading sooner or later to mental disorders, are studied to best advantage mostly in infants and children. Of epilepsy, which mostly starts early, it is not necessary to speak here. I shall only allude to the deformities of the cranium due to general or local premature ossification of the cranial bones and fontanels, to the peculiarities of the position of the teeth and ears, the retracted root of the nose, the asymmetry of the head and face, due either to unilateral atrophy or hypertrophy, and the shortened base of the skull. Besides, there is the excessive number of cerebral diseases manifest at a time when the increasing growth of the organs continues to add to the acquired lesions; also trauma and insolation. Finally, the impressibility of the young is such that the causes of mental disturbance in every age—chorea, hysteria, epilepsy, anomalies of the ears, nose, and heart, the presence of helminthes, the paroxysms of malaria, the anatomical results of typhoid fever, rheumatism, erysipelas, and pertussis, and the nutritive disorders resulting from anæmia, chlorosis, and alcohol—have very much more serious results when occurring at an early age. There are some causes leading to mental disturbances which are certainly more common in the young, —viz., imitation, fear, fright, masturbation, and the protracted mistakes constantly made in regard to training and education. The overworked brains of our school-children have been complained of in this connection as early as 1804 by Peter Frank, and will yet form the subject of a few more remarks.

The history of the embryo and fœtus finds its legitimate termination in that of the infant and child. Thus embryology, teratology, and pedology, with pediatrics, are but chapters of the same book. The scientific consideration of any one of them is impossible without that of the others. The theories of heredity and consanguinity refer equally to all. The most important changes and diseases met with in the young human being cannot be studied without the knowledge of its previous history, and the intelligent appreciation of embryology cannot be attained without the exact knowledge of its final outcome. Excessive or defective growth, arrest of development, and fœtal inflammation are the heads under which a large number of anomalies of the infant can be subsumed. The frequent occurrence of carcinoma, sarcoma, and lipoma in the young favors Cohnheim's theory, according to which those neoplasms owe their origin to the persistence of embryonic tissue. Abnormally inverted circulation explains the acardiac monstrosity; deficiency of building material accounts for the absence in many cases of limbs or parts of limbs. The laws of duplication, including intrafœtation, are now well understood, and the gigantic growth of limbs or parts of limbs, akromegaly, and macroglossia, are as important in the life of the born as they are interesting from the point of view of embryological development.

Many symptoms of rhachitis, syphilis, and hæmophilia cannot be understood except in their embryological connection. The same is valid in regard to congenitally dislocated and horseshoe kidney, and transposition of the viscera. Insufficient closure of embryonic fissures explains encephalocele, porencephaly, spina bifida, bifid uvula and epiglottis, split palate, lips, and cheeks, pharyngeal fistulæ, hernia, and the communications between the intestinal tract and the uro-genital organs, and the persistency and patency of the urachus.

Inflammatory processes give rise to spontaneous amputations, the adhesions of the placenta to the head, to the most severe forms of obstructions and defects in the intestine, to the stenosis of the pulmonary artery, the aorta, and the atrio-ventricular orifice.

I must not, however, multiply examples of the intimate correlation between embryology and the malformations and diseases of the child. These few instances, I believe, will suffice to show to what extent the most exact and special study of the anatomy, physiology, and pathology of the child is a connecting link between, and the safest foundation of, a number of the most important branches of medical research. Indeed, if all the teaching obtained from pedology and pediatrics could be disjointed from those branches, these latter would be stripped of their best material. Though the history of pediatrics is but a brief one, it can safely be stated that those specialties have been to a great part feeding on and been built up by the observations and investigations of men specially interested in the diseases of children. You will find, when you look over the programmes of the nine associations which now form the American Congress year after year, that topics which in future will be the legitimate province of the American Pediatric Society, have attracted much of their attention.

From the first hour of life the infant requires special study. Its diet has been a source of ever-watchful research on the part of many of the best minds. In modern times, Zweifel, Korowin, Biedert, Bouchard,—not to mention A. V. Meigs and Rotch among us,—have deserved well of the subject. Not only diet, however, and individual hygiene have been studied on the child; the most vital questions of public hygiene are also connected with pediatrics most intimately. Besides such as every thinking man is deeply concerned in, it is mainly two topics that attract the attention of those who take an interest in children. I allude to the school and to constitutional diseases. My remarks to-day can be but fragmentary; still, I must not, both in the interest of our science and human society, omit to emphasize the fact that it still appears as if our schools were establishments organized to produce near-sightedness, scoliosis, anæmia, and both physical and intellectual exhaustion. Contrary to the treatment a colt receives at the hands of its owner, human society, or the state, permits or directs that the powers of a child should be rendered unfit for its future functions, physical, mental, and moral, for these three are indelibly interwoven. It requires physical and mental education to fertilize the soil for the evolution of morals. Thus the physician, and particularly he who makes pediatrics his special study, is a pedagogue by profession. The question of school-house building and school-room furniture, the structure of bench and table, the paper and type in the books, the number of school hours for the average child and the individual pupil, the number and length of recesses, the hours and duration of intervening meals, the alternation of mental and physical training, the age at which the average and the individual child should be first sent, have been too long decided by school-boards consisting of coal-merchants, carpenters, cheap printers, and undertaught or overaged school-mistresses, not, however, of physicians. The health and vigor of the American child in early years seems, according to Bowditch, superior to those of the European. Why is the youth and maiden, particularly the latter, so inferior? Why is it that anæmia and neuroses eat the marrow of the land, and undermine the future of the country by degenerating both the workers and thinkers of the community, and the future mothers? If there is a country in the world with a great destiny and a grave responsibility, it is ours. Its self-assumed destiny is to raise humanitarian and social development to a higher plane by amalgamating, humanizing, and civilizing the scum of all the inferior races and nationalities which are congregating under the folds of our flag. Unless the education and training of the young is carried on according to the principles of a sound and scientific physical and mental hygiene, neither the aim of our political institutions will ever be reached nor the United States fulfil its true manifest destiny. That manifest destiny is not so much the political one of excluding Europeans from our continent,—North or South,—for indeed the participation of European civilization in the gradual work of removing barbarism ought to be very welcome,—but of raising the standard of physical and mental health to possible perfection, and thereby contributing to the welfare and happiness of the people.

Another subject in which, for the same reasons, pedology and pediatrics are profoundly interested is that referring to constitutional and infectious diseases. Most of them belong to early life, and therefore interest you in this society. The vast majority of them can be avoided, mortality greatly diminished, and ill-health resulting therefrom prevented. Ninety-nine cases out of every hundred of rhachitis need not exist. Before we were overrun with the poverty-stricken population of Europe, rhachitis was hardly known among us. Unless the social position of the many be improved and the laws of hygiene understood and obeyed, it will increase until we shall be at a level with Ireland, Switzerland, and Northern Italy. Where the prevention of syphilis lies, or ought to lie, we fully know. How we could avoid dysentery and typhoid, the number of which increases with the size of tenements, the insufficiency of sewers, with the number of large summer hotels, and defective drainage, we thoroughly appreciate. Scarlatina, morbilli, diphtheria, whooping-cough, need not destroy or maim hundreds of thousands if contagion were avoided; and, unless that be done, mankind, state, town, have not performed the most rudimentary function of their existence. After all, we need not boast of our civilization, which indeed requires healing and mending both from a social and medical aspect.

If we would but concentrate our means on fighting preventable disease and death as they concentrate them in Europe for the purpose of preparing for, and carrying on, wars! If we did, we should save as many hundred thousands as they seek to destroy. If, besides, but every physician knew and appreciated his duty and his honorable vocation, which consists in preventing and curing disease, and spending his best efforts in ameliorating human existence! What, then, shall we say of those of our brethren who do not feel it below their dignity to study electricity, or make believe they do, for the avowed purpose of supplanting the hangman?

Questions of public hygiene and medicine are both professional and social. Thus, every physician is by destiny a "political being" in the sense in which the ancients defined the term,—viz., a citizen of a commonwealth, with many rights and great responsibilities. The latter grow with increased power, both physical and intellectual. The scientific attainments of the physician and his appreciation of the source of evil enable him to strike at its root by advising aid and remedies. Such increase of knowledge as the combined efforts of the members of the American Pediatric Society can result in from year to year, such interest as it can raise in its own labors, such impetus as it can give to the profession at large in the direction of special research, such power as it can exert on the instruction in pediatrics of students in the medical schools, such influence as it may have among the wealthy public with a view to establish and endow special hospitals for infants and children, while proving beneficial to all branches of medicine, will be a lasting blessing to the community.

DOUBLE EMPYEMA.

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Benny S., thirteen years and eight months old, fell into an excavation eighteen feet deep on January 4, 1889. He was taken out unconscious and carried to an adjoining store, where he was thoroughly drenched with water applied to restore him to his senses. There were no evidences of injury to the head, nor were any of his ribs fractured. In a short time he was taken home, and a few hours later he was seized with a chill, with intense pains in the chest, fever, and cough with a bloody sputum. No history of vomiting of blood. On the third day of his illness he came under my observation, and the diagnosis of double pleuro-pneumonia was made, the percussion note being absolutely flat on the right side. A careful examination could not be made on account of the weak heart.

His condition growing worse, Professor A. Jacobi was requested to see him in consultation on the fifth day of the illness (January 9). We found him in such a precarious condition that it was not considered advisable to allow him to get up, in order to make a careful examination of his chest. Respiration 60, pulse 150 and very weak, temperature 104½ (rectal). The diagnosis of double pleuro-pneumonia was confirmed, and an extremely grave prognosis given. In view of the extensive pulmonary œdema present anteriorly, it was not thought probable that he would live longer than twenty-four hours. Free stimulation was ordered, half an ounce of brandy being given every half-hour, one mimim of fluid extract of digitalis, with three grains of camphor, hourly, and carbonate of ammonium every two hours.

Morphia was administered hypodermically once or twice daily in sufficient doses to quiet the pain and allay the restlessness present. His pulse continued weak and his general condition grave. The improvement was slow, and nearly a fortnight elapsed before I ventured to allow him to sit up in order to make a careful examination of the posterior portion of his chest. The physical examination now revealed fluid, and an exploratory puncture, pus. Tonics and free stimulation continued.

January 31 (twenty-seventh day of illness), assisted by Dr. H. M. Silver, the right pleural cavity was aspirated and more than a pint of pus drawn off, the further flow being prevented by the occlusion of the canula with lymph.

February 2.—Assisted by Dr. H. M. Silver, the left pleural cavity was opened posteriorly below the angle of the scapula and two large drainage-tubes were inserted. Large quantities of pus escaped; no broken-down clots discovered, or any evidence of an old hemorrhage into the pleural cavity. The pleura was now washed out with hot water, large lymph-masses escaping with the pus. Iodoform with bichloride gauze and borated cotton-dressing applied. The general condition contraindicated any extended operation, as the resection of one or more ribs; it was not even considered safe to employ an anæsthetic.

February 6, four days later, assisted by Drs. H. M. and L. M. Silver, the right pleural cavity was incised and drained. A large amount of pus flowed out and masses of fibrin came away. A number of these were three to four inches long and nearly three-fourths of an inch in thickness, and were readily removed with dressing-forceps. The quantity of pus which escaped from the two sides was so considerable that it was a matter of surprise that respiration was at all possible. No anæsthetic, local or general, was used. The two cavities were syringed daily with hot water and dressed antiseptically. For some time the urine contained considerable albumen, due no doubt to the interference or disturbance of the general circulation by the large effusions in both pleuræ. About the middle of the second week after the openings were made, the father was taught how to make the injections and apply the proper dressings. In the mean time, a large bed-sore developed, and added to the discomfort of the patient. Though the surroundings were poor, the improvement in his general condition progressed rapidly after the operations, and about the middle of March both tubes were dispensed with,—that is, in less than two and a half months from the commencement of his illness, and about five weeks from the time the incisions were made. The patient has been walking about for several weeks. About the second week in April even the sinuses had closed completely. The bed-sore over the sacrum, nearly four inches across, also improved rapidly and soon healed.

April 17.—Pulmonary expansion complete; no retraction of the chest-walls; breathing distinct over both lungs. No dulness. General condition excellent. Appetite good.

Through the courtesy of Dr. Neufield I am enabled to present a second case.

Nathan W., five and a half years old, fell from the seat of a wagon. He was senseless for a short time, but soon came to, and played around for several hours before going home. Now began to complain of pain in his head; vomited once; soon became feverish and somewhat delirious. The delirium was mild in character, and was present occasionally for a week. The fever, 104°–105°, continued. Some cough present. The patient soon fell into a typhoid state, with diarrhœa, brown dry tongue, and great prostration. The symptoms pointing to a lesion in the thorax were rather indefinite.

On the eighth day of his illness, Professor A. Jacobi was requested to see the patient in consultation. A physical examination excluded meningitis or fracture of the skull. An examination of the chest with exploratory puncture of the right plural sac revealed the existence of an acute empyema. An operation was advised, and the same evening, June 7, at the invitation of Dr. A. W. Neufield, I opened the right pleural cavity by an incision made posteriorly below the angle of the scapula, inserted a large drainage-tube, washed out the cavity, and then applied an antiseptic dressing of iodoform gauze and borated cotton. At the same time an abscess, which first made its appearance on the fourth day over the first metatarso-phalangeal joint of the left foot, was incised, drained, and dressed antiseptically. An examination of the left side of the chest revealed dulness upon percussion, and bronchial breathing with friction-sounds at the posterior and lower part.

June 16, Dr. Neufield asked me to see the patient again. The pleuro-pneumonia on the left side did not pursue a favorable course, and the doctor suspected that suppuration had occurred. An exploration with a hypodermic syringe confirmed his suspicions, and the following day the left pleura was opened. A large drainage-tube was introduced, the cavity washed out, and dressings applied. More than a pint of pus escaped. From this time on the general condition of the boy improved wonderfully. The dressings were changed every third day, and both pleural cavities carefully irrigated with warm water or warm bichloride solution (1–10,000). The fluid was allowed to flow in a gentle stream by means of a siphon-syringe held about a foot above the level of the wound. At the end of a fortnight from the time of the operations the boy was able to be taken out, and allowed to sit in the open air in a chair. With the general improvement the discharge diminished gradually, and in about a month less than one-half ounce was discovered on the dressings, which were now changed about every fourth day. Pulmonary expansion good. The lateral curvature, quite marked before the left side was operated, began to grow less, and now the patient walks pretty straight and without much stoop. The drainage-tubes, originally about three and a half inches long, have been shortened gradually, so that they only reach as far as the pleura, but do not extend into the cavity, and are only kept in position to avoid the possible danger of a reaccumulation of matter, an accident which may occur if the tubes be removed too early.

July 28.—The patient's general condition is excellent, both sides of the chest nearly equal. No dulness upon either side. The opening in the right pleura closed, and a small sinus only remains. No pus escapes upon forcible coughing from sinus or left pleural opening.

August 3.—About one-half drachm of pus expelled from the left side upon forcible coughing. Small drain inserted. The sinus on the right side has closed.

August 10.—General condition excellent. A small sinus about two inches long still present on left side.

August 25.—Sinus on left side closed; pulmonary expansion good; breathing distinct all over the chest; no dulness anywhere.

Aside from the bilateral character of the disease, the cases present several points of interest. In the histories we find that in both the affection was preceded by a fall. The question naturally comes up, Was the fall the direct cause of the double purulent effusion? In neither case were there any evidences of fracture of the ribs, wound perforation, contusion, or ecchymosis of the thoracic walls, nor was it at all probable that the lungs or pleuræ had been injured, giving rise to a hemorrhage into the sac, the blood breaking down later on and being transformed into pus. Were the latter the case, it seems but rational that blood-clots, more or less disintegrated, would have escaped with the purulent contents when the chest was opened. The relationship existing between the fall and the disease is somewhat obscure.

The bilateral character further seems to speak against traumatism as a direct cause, and would lead us rather to seek some constitutional condition. The older patient had been afflicted with general psoriasis for years, and at the time of his illness the extremities were pretty well covered with the scales. Furthermore, he was thoroughly drenched, and the exposure to the inclement weather prevailing at the time of the accident, no doubt, to one in his poor condition, was an important factor in the etiology of the case.

In the second case the boy fell about five feet, was senseless for a short time, but recovered quickly and played in the street for two hours before going home. Aside from the headache, he made no complaint, but went to bed and slept for several hours. During the night he became delirious and feverish. The pain in the chest did not come on for several days after. Aside from the mere statement of the fall and the pain complained of in the head, there is no evidence to connect his illness with the accident. No ribs were broken, nor were there any signs of injury to the thorax or other parts of the body, no swelling, no hemorrhage or wound, not even a contusion was present. The surroundings in his case and his general mode of living were unfavorable, and no doubt contributed in great measure to induce the grave type of inflammation.

Though aware of the presence of pus from an early stage of the disease in the older boy, I refrained from operating for a fortnight. My course of action in this respect may be open to criticism. The patient was extremely emaciated, presenting the physical appearance of one in the last stage of phthisis. The feeble state, together with the excessively weak heart, made me fear that operative measures employed early would precipitate a fatal termination. In the meanwhile, heroic stimulation was resorted to, and his general condition improved. The subsequent favorable course, I believe, justified me in acting conservatively in postponing operative measures until the improvement in his general condition warranted interference with reasonable prospects of success.

No anæsthetic, local or general, was employed. The sluggish capillary circulation, the weakened heart, and the excessive dyspnœa contraindicated the use of either chloroform or ether. In fact, if incision only be practised, an anæsthetic is rarely necessary. Sensibility to pain is less acute in these cases, for the blood is but imperfectly supplied with oxygen. The circulation being necessarily interfered with and less perfectly accomplished, the blood does not receive its proper supply of oxygen, the carbonic acid is in excess, and sensation is therefore more or less obtunded. When the incisions are made through the skin there is not much pain. This I have observed in children, as well as in young adults, in the operations for empyema.

Both patients lived in thickly-populated tenements, under such poor hygienic and sanitary conditions unfortunately existing in habitations where four families are compelled to live on one floor; and yet both recovered in a comparatively short period after free incisions had been made, drainage established, and irrigations resorted to. The irrigations were practised with the restrictions to be referred to later on.

The treatment of empyema is practically that of an abscess with partly rigid walls. The walls of the pus cavity are formed by the ribs and the intermediate soft parts, by the lung more or less compressed, and the upper surface of the diaphragm. On the inner aspect we have, in addition, the pericardium covered by the pleura as one of the boundaries. The large space which remains when the pus has been allowed to escape can only be obliterated by the ascent of the diaphragm allowing the displaced viscera to resume their normal position;

by the approximation or overlapping of the ribs; and, finally, by the re-expansion of the lung. One or more of these factors enter into the mechanism of cure in every case. The falling in of the chest-walls and the ascent of the diaphragm, though not inconsiderable, do not suffice to obliterate the cavity. The principal *rôle* is played by the expansion of the lung. To secure this, early diagnosis and early operation are essential, and it is to these two points that I attribute the rapid and complete recovery in the two cases presented.

Physical signs, it is true, will tell us that fluid exists; exploratory puncture only will determine the character, whether purulent or serous. As the result of a somewhat extended experience, I heartily endorse the following utterances of Donaldson ("Diseases of the Pleura:" Pepper's "System of Medicine," vol. iii. page 548): "We cannot forbear to urge the importance of promptly and definitely settling the diagnosis by exploratory aspiratory puncture. Properly guarded, no evil can result; whereas a positive diagnosis enables us to act promptly with effective mechanical means of relief." I lay particular stress upon this point, for but two years ago, at a meeting of the New York Academy of Medicine, I was criticised for advocating early exploratory puncture in pleural effusions in childhood.

Our object in operating is to evacuate the pus, to provide, furthermore, a free channel for the escape of the flocculi and large masses of febrin present, and to allow the necessary irrigations and free exit of the injected solution. In acute or rather recent cases of empyema—and my remarks are intended to apply to this variety only—a free incision without any resection of the ribs answers these indications, and generally is sufficient to effect a cure. I have usually selected, as the site for the opening, the first or second intercostal space below the angle of the scapula. In this situation drainage is effectual, whether the patient is in an upright or a horizontal position. The incessant movements of the thoracic walls too assist in forcing out the pus, and the costo-diaphragmatic sinus is kept free. Immediately before operating, the exploring syringe should be inserted, as a crucial test to establish the presence of pus, at the point where the incision is to be made.

Pus being detected, the soft structures should be divided, layer by layer, to the extent of one and a half to two and a half inches, the index finger feeling the various tissues as we divide them. The pleura having been opened and the pus allowed to escape more or less slowly, according to the condition of the patient, the pulse being carefully watched, the largest size drainage-tube is inserted, and the cavity irrigated with hot water or (1–10,000) bichloride solution. An antiseptic dressing is now applied, and changed when saturated or the temperature becomes elevated. In performing irrigation the greatest caution should be observed that a gentle stream only is employed; that the fluid be at a proper temperature, and its free escape not interfered with. It has been my practice to employ a siphon irrigator, improvised from Whitall, Tatum & Co.'s siphon nasal douche, the nozzle being replaced by a piece of glass tubing, and the vessel holding the antiseptic solution being held about one and a half to two feet above the level of the wound.

This little apparatus is compact and inexpensive, and makes an excellent irrigation in general. The injections are made regularly until the flocculi and masses of fibrin have disappeared; subsequently only when the temperature is elevated or the discharge becomes offensive.

The drainage-tube is secured by employing a piece of rubber bandage one and a half inches square, with a central perforation, through which the tube split longitudinally for about an inch is passed. The divided ends are then turned down and fastened to the square of rubber (acting as a shield) with small safety-pins or wire sutures, or the split portion of the tube is turned down and transfixed with a large safety-pin, no shield being used. The latter plan I first saw used in the practice of my friend, Dr. H. M. Silver.

In Pepper's "System of Medicine" the subject of double pleurisy is dismissed in thirteen lines. This form is usually secondary to rheumatism, or more frequently it follows tuberculosis (Louis). Gangrene, too, may give rise to this variety. The progress of the disease is rapid, and the result is almost always fatal. Double empyema is not mentioned. In the various text-books the subject is not discussed. In reviewing the literature of empyema, less than a dozen cases were met with. A list of these accompanies this paper.

Two other cases have come to my knowledge, one in the practice of Dr. A. Caillé, in which the trouble followed typhoid fever, and yet the patient recovered. The other occurred in the practice of Dr. A. F. Brugman, also recovered.

Hampeln. "Empyema Duplex."—*St. Petersb. Med. Wochenschr.*, 1881, vi. 133.

Hetherington. "Double Empyema."—*Med. Press and Cir.*, London, 1878, n. s. xxvi. 472.

Metcalf, J. T. "Empyema on the Right Side, Acute Pleurisy on the Left, simulating Pericarditis."—*N. Y. Med. Times*, 1855, iv. 277.

Demme, R. "Behandlung eines konsekutiv doppelseitigen Empyems durch Rippenresection."—*Med. Ber. ü. d. Thätigk. d. Jenner'schen Kindersp. in Bern* (1880), 1881, xviii. 93–96.

"Epanchment pleuritique successif dans les deux Côtés de la Poitrine; Double Opération d'Empyème; Guérison."—*Ann. de la Méd. physiol.*, Paris, 1834, xxv. 571.

Sangster, J. I. "Double Empyema treated by Incision and Aspiration; Recovery."—*Lancet*, London, 1880, ii. 617.

Clurton, T. "Double Hemorrhagic Pleurisy; Degeneration of Cells with Formation of Cholesterine; sub. Empyema on Right Side; Operation and Recovery, followed by Empyema of Left Side; Operation, Septicæmia, and Death."—*Tr. Clin. Soc.*, London, 1882, xv. 19–26.

Branser. "Doppelseitiger Brustschnitt."—*Aerztl. Int. Bl.*, München, 1883, xxx. 461.

Spampacchia, R. "Un Caso di Pleurite Bilateral et di Peritonite."—*Riv. Chir. et Terap.*, Napol., 1883, v. 485.

Gardiner, H. C. "Empyema (double primary) with Recovery."—*Med. Rev.*, New York, 1888, xxxiv. 177.

Caillé, A. "Double Empyema following Typhoid Fever; Recovery."

Brugman, A. F., and Dr. Holmes. "Empyema in a Child Six Years Old; Recovery."

O'Kell. "Double Empyema; Restriction of Rib on Right Side; Incision and Free Drainage on Left Side; Recovery."—*London Lancet*, July 21, ——.

DISCUSSION.

Dr. A. Caillé did not consider it advisable to allow pus to remain in the pleural cavity, but would evacuate it as soon as discovered. In peritypbilitis, in exceptional cases, the pus may perhaps be permitted to remain for a time if the patient is in such a condition of collapse that an operation at such a time would presumably prove fatal. In pyothorax the pus is a direct impediment to the circulation by its compression of part of the lung, and it should be removed promptly.

Dr. H. Koplik would not irrigate the pleural cavity too frequently; usually only once, immediately after operation. The re-expansion of the lung and attacks of coughing forces the pus out, and the irrigation of the pleural cavity may in some way injure the lung. The irrigator should be avoided in ordinary cases. He doubted the probability of empyema being the result of traumatism where there was no actual penetration into the pleural cavity or solution of continuity of the skin.

Dr. William Pepper referred to the strong tendency of unilateral empyema in children to recovery under any careful mode of operative treatment. He had now operated without incision between one thousand and eleven hundred times in cases of pleural effusion; not in that number of distinct cases, but had performed the operation that number of times in all. In no instance had there been any serious consequences from the operation itself. It was impossible, speaking from memory alone, to say how many cases of empyema in children were included in this number. The instances must, however, be numerous, certainly not less than thirty or forty. In every case, without exception, recovery had followed. The operations were by aspiration, with subsequent thorough drainage, with careful asepsis. In some instances the drainage-tube was passed around one of the ribs by means of a curved needle. More frequently the drainage-tube was introduced into the chest through the canula, after the collection had been evacuated. His experience with double empyema, whether in adults or in children, had unfortunately been very different. It seems very difficult, therefore, in view of the recovery which generally follows in such cases of unilateral empyema in children, to estimate the relative merits of different modes of operating; and these remarks were offered with a view of supporting the propriety of the easier and simpler modes of operating in empyema in young children. If the condition is diagnosed promptly, and treatment is at once instituted, the prognosis is eminently favorable.

Dr. William Osler considered empyema a surgical affection. Free, full, and satisfactory incisions should be made in case of adults, but in children aspiration should be first tried. Many cases at an early age are cured by one aspiration. The aspiration should not, I think, be repeated, but if the pus reaccumulates incision should be practised.

Dr. C. P. Putnam was not in favor of irrigating, even once, as a routine practice, and without some special reason for it. Ordinary cases do as well or better without irrigation.

Dr. W. L. Carr does not irrigate in cases of empyema, and in dressing the wound uses antiseptic precautions. A case just seen did not have any rise of temperature after the operation. The pleural cavity was not washed out.

Dr. L. Emmett Holt considered aspiration by a trocar and drainage through a canula as an imperfect substitute for incision. He had collected, two years ago, statistics of a large number of cases of empyema operated on by various methods. These show that while a single aspiration succeeded in a considerable number of cases of localized empyema, it was almost never successful when the empyema was generalized. Washing out the pleural cavity seemed to him unnecessary, except in cases where the contained fluids were very foul and offensive. He thought, in some cases at least, frequent irrigation of the pleural cavity served to keep up the discharge. He was strongly in favor of free incision, aspiration being used as a preliminary step.

Dr. J. H. Fruitnight thought that the most satisfactory results were to be achieved by incision, but that constant irrigation seemed to act as an irritant to the pleural sac.

Dr. H. N. Vineberg thought that the general practitioner did not make an exploratory puncture often enough. Empyema was frequently overlooked, and it was not uncommon to meet with cases that had been under treatment for months without their nature being recognized.

Dr. A. V. Meigs said that in empyema the opening can be made too low down, and in illustration of this point related that he had had charge of a case in the Pennsylvania Hospital in which the operation failed to cure the patient, because, though at first the drainage-tube was in the pus-sac, as the cavity healed from below and became smaller the tube ceased to empty it, and at the autopsy there was found a large amount of pus in the pleural cavity, and the drainage-tube below this lying between the ribs and diaphragm, which had become adherent to their inner surfaces.

Dr. H. Koplik.—The point in regard to the location of the incision referred to by Dr. Meigs is also made by Professor Koenig.

Dr. Francis Huber expected adverse criticism. Said that Dr. Caillé would probably have done the same under similar circumstances. Constant irrigation should only be used where there is elevated temperature and fetid discharge. He gave illustrative cases. When pus is found on the introduction of the needle, it must have been there before, and could not possibly be due to the puncture. Puncture of the lung gives rise to no ill results. It does not convert a serous into a purulent accumulation when ordinary care is observed.

THE APPARENT PHYSICAL PARADOX INVOLVED IN THE RE-EXPANSION OF A COLLAPSED LUNG WHILE A FREE OPENING REMAINS IN THE PLEURAL SAC.

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THE reinflation of a collapsed lung while the surface of that lung is freely exposed to the pressure of the atmosphere through an opening in the pleural cavity, has always appeared to me in the light of a physical paradox. None of the theories so far advanced offers any satisfactory explanation of the mechanism by which this process is accomplished. If the inspiratory movement be nothing more than the production of a partial vacuum within the chest, with consequent inrush of air until the pressure is equalized, there can be no force developed by this movement to overcome the contractility of the lung, because, the atmospheric pressure being the same in both situations, the power to create a vacuum is destroyed. Foster, in his work on physiology, in describing the mechanics of respiration, concludes as follows: "It need hardly be added that when the pleura is punctured and air can gain free admittance to the pleural chamber, the effect of the respiratory movements is simply to drive air in and out of that chamber, instead of in and out of the lungs. There is, consequently, no renewal of the air within the lungs under these circumstances."

Now, if this physiological view of the question were true, it would be easily understood. The lung would simply remain contracted as long as the external wound remained patulous, and there would then be no room for argument. But every one who is familiar with the treatment adopted for the cure of empyema knows that clinical evidence is directly opposed to the teaching of physiology in this instance. He knows not how it is accomplished, but he knows the fact that a lung that has been completely collapsed and compressed becomes so fully and perfectly reinflated that in after-years it is impossible to distinguish any difference between the two sides, and that the principal part of this reinflation takes place while free communication exists between the pleural sac and the atmosphere. Air, therefore, does find its way into the collapsed organ, as well as into the pleural chamber, and in some manner acquires sufficient increase of power to overcome not only the resistance offered by the elasticity of the lung, but also that of the fibrinous material on its surface, and the results of the compression to which the organ had been subjected. The theories usually advanced in explanation of this phenomenon are as follows:

1. The small size of the opening in the pleural cavity, or its valvular form, produced by the dressing or otherwise, which tends in some measure to exclude the air.

2. The presence of old adhesions, which prevent complete collapse of the lung, or the formation of new ones acting in a similar manner.

3. The force brought to bear on the contracted lung by the recoil of air from the sound side in the act of coughing, or other forcible expiratory effort.

As far as the size of the opening or its valvular arrangement is concerned, I can say, from my own experience alone, that it has no influence whatever in aiding the expansion of the lung by excluding the air, as it has always been my practice to make a free opening, and keep it so by a metallic tube. The only dressing applied consisted of a thick layer of oakum, which does not interfere in the least with the free entrance and exit of air.

Old adhesions seldom exist in cases of empyema in young children, and need not be considered. Before new adhesions can form the opposing surfaces of the pleuræ must not only be brought in contact, but held in that position for some time. When the chest is completely filled with fluid before thoracentesis is resorted to, these surfaces are separated by a considerable distance at all points, and more or less expansion of the lung is necessary before they can be approximated, even at the apex, where the interval is least. Even granting that adhesions may form at the apex, where there is practically no movement of the walls of the chest, still it would be difficult to understand how they can extend downward, when we remember that the tendency of the lung is always to contract; that its elastic tissue is always on the stretch until every particle of air is driven out and the alveolar walls are brought in contact. This contractility of the lung is no insignificant force. Hutchinson and others have estimated that in the adult male it offers a resistance to the entrance of air equal to lifting a weight of one hundred and fifty pounds with every inspiration. The mechanism by which this impediment to the inflation of the lungs is met and overcome by the action of the inspiratory muscles is as easily understood as that of a cupping-glass, so long as the walls of the chest remain air-tight.

The last theory connected with the physics of respiration that remains to be considered is the effect of forcible expiration on the collapsed lung while the glottis is either partially or completely closed. Here we have to deal, not with the pressure of the atmosphere as in inspiration, but with compressed air, the amount of compression being in proportion to the muscular effort brought to bear and the obstruction offered to its escape by the degree of closure of the glottis. Cough is probably the most powerful of these efforts, and this only will be considered.

During the first part of this act the glottis is completely closed, and it is reasonable to suppose that some of the temporarily imprisoned and condensed air will be driven in the direction of least resistance,—that is, from the sound into the contracted lung.

When discussing this subject on a former occasion I referred to the act of coughing as probably accomplishing nothing more than starting the process of dilatation. But since that time, and especially since studying the subject of hernia of the lung, I am convinced that the dilating effect of this act is very great. Hernia of the lung, though very rare, even as a primary accident of penetrating wounds of the thorax, does sometimes occur secondarily.

While the contractile power of the lungs is great they also possess the opposite quality of distensibility to a marked degree, and are capable of being expanded far beyond the limits of the cavities that contain them without injury to their tissues. If a wound be made in the chest, without injuring the visceral pleura, at the end of a full inspiration or the beginning of a forced expiration, it is easy to understand how a portion of the lung may be forced through the opening. But in the case of secondary protrusion, where the opening has existed for some time and the lung is collapsed, reinflation can occur only by means of air pumped in from the sound side by the act of coughing or other violent expiratory effort.

There can be no doubt, therefore, that were this act repeated with anything approaching the frequency of the normal respiratory movements, it would not only be sufficient to re-expand a contracted lung, but to hold it in that position indefinitely, regardless of the size of the aperture in the pleural chamber; provided, of course, that the other lung remain intact to supply the air necessary for the expiratory muscles to act on. But here we are met with two serious objections to this apparently satisfactory solution of this perplexing question: (1) that the cough is not repeated often enough,—in fact, some children with empyema cough very little; (2) that this act cannot be effective when both pleural cavities are open at the same time, as in the cases of double empyema reported by Dr. Huber.

Assuming that the lung is expanded by a fit of coughing until the visceral and parietal pleuræ are brought in contact, the moment the distending force is removed contraction begins and continues, if not again interrupted, until the organ is reduced to a state of atelectasis. There is also the inspiratory expansion of the chest operating in the opposite direction, which draws the ribs away from the lung before there is time for adhesions to form. When both pleural cavities are open at the same time, there can be no recoil of air from one lung to the other, because both organs are practically in the same condition; and unless adhesions exist over the still permeable portions, sufficiently strong to resist the weight of the atmosphere when admitted, it is difficult to understand how inspiration can be carried on at all, or life be sustained even for a moment. Dr. Weissberger, in an article on this subject, published in the *Berliner Wochenschrift* of February 24, 1879, takes it for granted that the positive expiratory pressure, aided by the negative pressure of inspiration, produces sufficient expansion of the contracted lung to allow adhesions to take place above, and then endeavors to demonstrate the manner in which the inflation extends downward where the pleural surfaces are more widely separated. In other words, he assumes the accomplishment of the very steps of the process that are the most difficult to explain or understand, and this is the weak point in all these theories.

In the paper already referred to* I suggested the possibility of a physico-chemical force generated by the interchange of gases in the pulmonary vesicles, which would supplement the pressure of the atmosphere in drawing air into the lungs, or at least in holding it there when once admitted. If such a force exist, it must be the result of attraction between the oxygen and the hæmoglobin, for here we have to do, not with simple diffusion, but a chemical union. This hypothesis is sustained by Draper's theory that the capillary circulation is carried on by an attraction, nutritive or chemical, existing between the blood and the tissues, and that the force thus generated is sufficient to draw the blood into and through the capillaries from the terminal arteries, where it is deposited by the heart. But there can be no nutritive attraction in the lungs, because the blood is sent there only to receive its supply of oxygen and get rid of its excrementitious products. Here the attraction of the oxygen for the hæmoglobin is substituted for that of the tissues, and if the force be sufficient to draw the blood through the pulmonary capillaries it operates equally in the opposite direction, and aids in retaining the air in alveoli and keeping them patulous, if nothing more.

The mechanical theory of the circulation, which assumes that the action of the heart is sufficient to propel the blood through the whole circuit, from the left back to the right ventricle, does not explain the important fact that venous blood will not circulate in the systemic capillaries. Now, venous blood contains all the elements of nutrition excepting oxygen, and also contains more water than arterial blood, yet the same action of the heart cannot drive it through the capillaries, because there is no attraction between it and the tissues. The fact that defibrinated venous blood can be driven through the double capillary circulation of the intestines and

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* *New York Medical Journal*, March 9, 1889.

liver after death with less force than the normal arterial pressure proves nothing. All physiologists admit that it does not occur during life.

Flint, who claims that the power of the heart alone is sufficient to carry on the circulation, speaks on this question as follows: "The distention of the heart in asphyxia is, therefore, due to the fact that unaërated blood cannot circulate in systemic capillaries."

There is still another factor that may contribute to some extent in preventing the rapid collapse of a functionally active lung. This is the vaporization of a considerable amount of water existing in the liquid state in the capillaries, and suddenly converted into vapor in the alveoli, the escape of which is retarded by the many minute and tortuous channels through which it has to pass. An adult exhales with the breath about twenty ounces of water in twenty-four hours. Roughly estimated, a cubic inch of water represents a cubic foot of steam. Such a vast increase in volume of even a small quantity of water must exert some mechanical effect in keeping the pulmonary vesicles and smaller air-passages pervious, or, in other words, assist in keeping the lung expanded.

From the foregoing facts, I think we can understand the process by which a collapsed lung, under the conditions described, is re-expanded, even until the pleural surfaces are brought together; but it appears to me that some other force of such a nature as I have suggested is necessary to hold it in that position long enough for adhesions to form.

DISCUSSION.

Dr. W. P. Northrup, of New York, said: Dr. O'Dwyer, on a former occasion, in a partial discussion of the present subject, quoted extensively from a "Bradshawe Lecture on Pneumothorax," by Samuel West, F.R.C.P., London. In that lecture, quoted by Dr. O'Dwyer, are these words: "The fact, therefore, that the pleural cavity may be laid open, and that yet collapse of the lung with consequent pneumothorax may not occur, must be accepted and an explanation sought." Again: "When the lung does not contract after the pleura is opened, it must be kept on the stretch by some force greater than seven millimetres of mercury (the force of normal elasticity of the lungs, Donders and Hutchinson), and there seems to be no place for such force to exist, unless it be in the pleura itself; and if here, it is probably to be found in the *cohesion* between the two serous surfaces." Then follows elaborate experiments with disks of wood, upon which are stretched stomachs and other membranes, the cohesion of which when wetted and applied, the one to the other, shall demonstrate that a lung will not let go its hold upon the parietal pleura except under force directly applied. I quote still further, in order that we may in no point misapprehend his meaning.

He continues: "The result of these observations is to prove that there is some force other than atmospheric pressure by which those two smooth surfaces are held together; and without using the term in too technical a sense, I may speak of it as cohesion." Again: "Pneumothorax can therefore no longer be regarded as a condition to which there is an inherent tendency in the healthy body, but, on the contrary, as a condition brought about by the forcible separation of the pleural surfaces, and in this respect exactly analogous to the distention of the subcutaneous tissue which occurs in surgical emphysema. . . . It would seem to follow as a corollary that the force required to distend the subcutaneous tissue must be less than that required to separate the layers of the pleura. . . . Surgical emphysema . . . may in reality be a protection against it (pneumothorax), the air making its way in the direction of least resistance beneath the skin rather than between the pleural surfaces. It is evident, further, that where the pleura is laid freely open, so that the air passes away without hinderance on expiration, the liability to pneumothorax will be still further reduced."

It occurred to me that the simplest way to ascertain the behavior of the lung when the pleura was opened was to open a pleura and look at it. Disks of wood covered with stomach may be better, but are difficult to get, and dogs are plenty; besides, the conditions may not be identical. I am indebted for these experiments to the courtesies of the Loomis Laboratory and to the valuable assistance of the director of its physiological department, Professor W. Gilman Thompson, and his assistant, Dr. Cardwell.

Question: Is there sufficient cohesion between the two pleural surfaces to maintain them in apposition, the costal pleura having been opened without injury or violence to subjacent tissues?

Experiment I.—A street cur weighing about twenty-five pounds. Ether.

Having trimmed away the hair, a free incision was made parallel with the sixth and seventh ribs, reaching down to the intercostal muscles at a point midway between their angles and their sternal cartilages. The intercostals were cut upon a grooved director till no tissue overlay the lung at the bottom of the incision, except the parietal pleura. Through it could be seen the fully-expanded lung gliding back and forth in rhythmic respiration. The pleura was then lifted on a fine-pointed forceps, and a pin-hole opening made in the parietal pleura, without injury to the visceral layer, and without allowing any force to crowd the lung away from the ribs or separate the two serous leaves. Even with a pin-hole opening there was an instantaneous recession of the lung; on the next expiration a fine thread of air was expelled, and by the second respiration the lung was not to be seen at all, and a probe passed two and a half inches straight down before it reached the lung.

Experiments II., III., IV., and V. were followed by exactly the same results in every particular, and were performed on dogs of various sizes and conditions of nutrition, but all healthy. According to Mr. Samuel West's experiments, reported by himself, we should expect the force of cohesion to keep the pleural surfaces gliding upon each other on all margins of the fenestra. Disks of wood covered with stomach and divers membranes, according to West, cohered with a force equal to and more than seven millimetres of mercury, the estimated elasticity of the normal lung.

Experiment, Second Series.—Made with a view to learn something of the behavior of the lungs when one and then both pleuræ have been opened. A strong, well-nourished dog, of about twenty pounds weight, was etherized, and a double-flanged canula, the diameter of the hollow cylinder being half an inch, was inserted (buttoned in) between the sixth and seventh ribs, about midway between their angles and the costal cartilages. Dyspnœa became marked immediately on entrance of air to the pleural cavity, the animal, of course, lying upon the more useful lung. The operation completed and the lips of the wound stitched about the canula, a close-fitting cork was inserted at the end of expiration. Immediately the breathing became slower and less labored and finally the animal seemed to be suffering no embarrassment whatever from the opening.

The same operation was then performed on the other pleura of the same dog, a canula of three-fourths of an inch diameter inserted and corked tightly at the moment of finished expiration. The dog was placed on the floor and allowed to come out of ether: he was shortly on his feet, trotted back to his old corner, breathed to all appearances like any dog that had taken ether, and suffered no further interference. When led, he trotted about, wagged his tail, and seemed comfortable; when fully recovered and standing in the middle of the laboratory, one cork was withdrawn without any immediate effect. When led away from the operation-table he trotted cheerfully, wagging his tail; when headed towards the table and ether he struggled with vigor, these exercises causing some dyspnœa, but not much. The half inch canula was the one open at this time. After a little rest, with both corks in, and standing in the same place, both corks were simultaneously removed, and the dog left to himself. He stood for a moment dazed, panting moderately, answered a chirping call, wagged his tail, and trotted off into the next room, among the monkeys and guinea-pigs. From there he was brought back, struggling moderately, and tied to a table-leg. This was about two minutes from the removal of both corks.

Now began his severe dyspnœa, and it seemed to come over him rather suddenly. He swayed to and fro, his eyes, tongue, and lips became dusky, and with feet braced wide apart he wavered and settled slowly to the floor. Here he lay flat on his belly, panting. Both corks were now replaced as before, catching the moment of finished expiration, in order to leave as little air as possible in the pleural cavity. In a few moments he was again as good as new. With one cork out the dog had suffered no dyspnœa when quiet, out of ether, and on his feet; with both out he succumbed in two minutes to urgent dyspnœa with deep cyanosis. I may add that the result of this experiment is quite in accord with the experience of Dr. Thompson on a former occasion.

Experiments, Third Series.—A small street cur, poorly nourished, weighing about ten pounds, having served for another experiment, was subjected to further operation, being still under ether. A large opening was made in his thorax, practically obliterating one wall. Dyspnœa and shock were severe, and the animal seemed about to succumb. Just at the instant of a severe spasm of the abdominal muscles with spasmodic closure of the glottis, a piece of plain glass was clapped upon the wet tissues of the thoracic wall, completing temporarily its continuity and enabling the animal, after some assistance, to resume respiration: the observers were edified to see the lung gradually expand, become rose-colored, and nearly fill the cavity, which it would probably do in a moment more. Just then the dog, which was a poor subject, ceased breathing altogether and died.

Acting on the suggestion just received, we made haste to etherize a strong, well-nourished dog of twenty-five pounds, selected a site of operation, and proceeded to make a window in his chest. Provided with a circular glass, we made a cut in the skin just sufficient to let the glass pass like a button through a button-hole, cut down upon the sixth and seventh ribs in the usual location, stripped off their peritoneum, and cut out two inches of the bones, gathered the pleura containing the vessels belonging to the two ribs within two ligatures, at the proximal edge of the wound, and snipped away the pleural membrane, leaving a nearly bloodless wound, about a fenestra two by two inches.

The dog being allowed to come out of the ether a trifle, gave a spasmodic expiratory impulse; the glass disk was buttoned quickly through the slit in the skin and instantly respiration improved. A single stitch rendered it assured that the bull's eye would not slip away, and the dog was allowed to get rid of more of his ether. The glass window acted secondarily like a valve. At each respiration a few bubbles escaped at the margin, but no air entered. Finally the lung was fully expanded, and gliding rhythmically back and forth upon the glass as upon the pleura-covered wall. At this point the dog evinced great activity, got upon the floor, walked about, wagged his tail, and went to his old corner. He was quickly secured, and to save suffering was etherized to death.

The President.—What would Dr. Northrup conclude from his experiments? Would he conclude that as soon as the chest is opened the lung will collapse entirely or to a certain extent; that it will not expand entirely while the chest remains open but that it will expand to a certain extent?

Dr. Northrup.—My first conclusion is that Mr. Samuel West was wrong. His experiments might work with disks of wood and membranes, but not with the pleura. In further answer, I would say that it has seemed to me that there is a state of equilibrium, with the elasticity of the lung on one side, and on the other the pressure of the air within, assisted by a certain amount of force from the blood, the blood-vessels acting, if I may say so, as erectile tissue. There is not complete collapse, and the lung fluctuates in the anterior and upper portions in unison with the motion of the other lung.

As to the last half of the question: Will the lung expand entirely or in part, the chest-wall remaining open?

I have adhered thus far strictly to facts, and a few facts are the only contribution I intend to make to the discussion. All the dogs under observation, while recovering from ether, made repeated attempts at vomiting,—that is, with closed epiglottis they tried by means of their abdominal and thoracic muscles to express the contents of the stomach through the œsophagus, which act is very similar to the act of coughing. In the repeated retchings one dog failed to express the contents of his stomach, but did compress the sound lung, and force air from it into the contracted lung, till, from being small and cyanotic, it became aërated, rose-colored, and expanded to its full capacity. In another case the lung was forced out through the canular opening, which was an inch and a quarter long from within out. This was, in fact, an exaggerated pulmonary hernia. Its expansion was complete at the moment, but, there being nothing to maintain its expansion, it immediately contracted again. This muscular action is similar to and almost identical with that of coughing, and serves to fortify the position taken by Dr. O'Dwyer that cough exerts the strongest expiratory force.

One practical point is suggested to my mind by the behavior of the lung under the glass window. It will be remembered that the plain glass, pressed against the wet tissues, acted like a valve, allowing air to bubble past its edges on expiration, but becoming the closer applied on inspiration, and air-tight. It soon came about, especially if the animal made any attempt at vomiting, that the lung was fully expanded and aërated, and in this condition, by means of the glass, could be maintained. It suggests to my mind the desirability of a valvular canula with which to drain empyemic chests. I wish also to say that, in my experience and observation, all dressings which catch the tenacious discharge from an empyemic cavity can act more or less as a valve. Take oakum, even, and its coarse meshes may become filled, and form against the end of the tube, whether hard or flexible, a pad which will allow the exit of pus and air, but which, on inspiration, will apply itself to the aperture, and effect, more or less effectually, a closure,—sufficiently, at least, to disturb the equilibrium in favor of diminished external pressure.

The President.—The experiments of Dr. Northrup would seem to show that when a hole is made in the chest-wall the lung collapses, but when the hole is closed the lung expands. But it must be closed air-tight. This would correspond with what Dr. O'Dwyer assumes. Dr. O'Dwyer says that the lung expands. Why does it? Dr. Northrup says that it does not expand so long as the chest-wall is open.

Dr. Northrup.—The lung of dogs does not.

Dr. O'Dwyer.—The experiments of Dr. Northrup were of very short duration.

Dr. W. L. Carr.—In the *Medico-Chirurgical Transactions*, vol. lix. p. 165, is an article by Douglass Powell, "On Some Effects of Lung Elasticity in Health and Disease." He makes the statement "that we recognize the fact that in the normal position of thoracic repose the contractility of the lung is exactly counterpoised by the elastic resilience of the chest-wall. This may be called the eccentric thoracic resistance. It is obvious, however, that the elasticity of the chest-wall is a force not only in favor of inspiration at the commencement, but against expiration at the termination of the respiratory act. It renders easier the expansion of the chest by neutralizing the first resistance and inertia of the lungs, and in the final contraction of the chest in expiration exercises a buffer-like action in taking off the shock of recoil."

In connection with some of the questions raised by Dr. O'Dwyer, it may be well to quote from some of the authorities. According to Ewald, we find in open pneumothorax not over five per cent. of carbonic acid, and almost twelve to eighteen per cent. of oxygen. In closed pneumothorax, however, we find fifteen to twenty per cent. of carbonic acid, and ten per cent. at the most of oxygen.

Fagge, in his "Principles and Practice of Medicine," vol. i. p. 943, states that in some very exceptional cases of pneumothorax the air gradually undergoes absorption, and complete recovery takes place. On page 936 he says that the chemical nature of the air was investigated by Dr. John Davy (*Phil. Trans.*, 1823) many years ago, and analyses have since been made by other chemists. It has always been found to consist mainly of nitrogen, and the amount of carbonic acid in it has generally been greater than that of the oxygen. . . . Obviously, therefore, it must have undergone change while in the serous space, either as the result of action upon it of liquid effusion, or in consequence of the absorbent energy of the pleural membrane, which is very considerable.

Of further interest, I will read the following from a personal letter from Dr. William H. Welch, of Baltimore.

"I have never noticed any expansion of the lung exposed freely to the atmosphere by an opening in the chest-wall. I have made experiments upon animals bearing upon this point, and am prepared to assert quite positively that under these conditions no expansion takes place, nor can I conceive it possible that the physical conditions admit of any expansion.

"I cannot understand in what way the inspiratory force of the diapraghm and of the accessory muscles of respiration could suffice to produce any expansion of a lung freely exposed to atmospheric pressure through an opening in the pleural cavity. If you will test the matter on any lung removed from the body or in the chest, subject to the conditions named, I think that you will find that the elasticity of the lung has no power to cause expansion of the lung after the pressure of fluid from the external surface of the lung is removed. Unquestionably there is some interchange of gases between the blood in the subpleural blood-vessels and the atmosphere in the pleural cavity. I should suppose that the thickness of the pulmonary pleura would interfere materially with the rapidity of this gaseous interchange.

"I should say that with or without paracentesis, if the entrance of air through the bronchial tubes is prevented, the lung will collapse, certainly not expand. Experiments have been made which show that under these circumstances the gases are absorbed from the air-cells, which then collapse.

"The arrangement of the blood-vessels in the pleural membrane is not adapted for anything like so rapid an interchange of gases from this surface as is the arrangement of blood-vessels in the air-cells, and I cannot imagine that, even with a free exposure of the pleural surface to direct atmospheric pressure, there can be from this surface as rapid an interchange of gases as from the walls of the air-cells.

"I apprehend that the basis for the discussion of the point as to the possibility of expansion of a lung while there is still an opening in the chest-wall must be observation of cases where adhesions have formed between the pleural surfaces. Such adhesions must alter the physical conditions, and it is quite possible to understand how these adhesions could be arranged as to permit of considerable pulmonary expansion, even when there is an opening in the thoracic wall."

We must remember that in most cases the collapse of the lung is caused by an inflammatory condition which interferes with the normal expansion and aëration, while after the paracentesis it is possible, as the authors quoted show, for the pleural surface with its underlying blood-vessels to absorb a certain amount of oxygen, even when exposed to the atmospheric pressure. The close association between the action of the chest-wall and the lung has of course been interfered with, and some of the apparent pulmonary expansion is perhaps due to a change in the expansion of the thorax.

The President.—I understand that Dr. Welch says that no expansion of the lung can take place while there is an opening in the chest. We, however, know, as the result of clinical observation, that the lung does expand nevertheless. No reasoning can gainsay the fact. What we observe at the sick-bed is just as accurate as what is observed in dogs, particularly dogs under the influence of chloroform or ether, whose muscular tissue probably does not act as does normal muscular tissue. No theory will do away with the fact that a lung which is not closely adhering or compressed by bands or splenization, does expand after thoracocentesis.

Dr. John A. Jeffries, Boston.—It is a fair question to ask whether or not any dressing was applied in these cases. Again, when we have the pleura covered with fibrin there is a different cohesion from that of the ordinary pleura. Then there is a certain possibility of mechanical union, and slow contraction as connective tissue forms from the sides of the cavity.

The President.—Does Dr. O'Dwyer believe that the lung will never be held back except by adhesions?

Dr. O'Dwyer.—I claim that the lung can be expanded by the simple mechanical movement of expiration, the air being forced from one lung to the other. I claim that hernia of the lung can be produced by this force. I, however, do not know of any reason why the two surfaces should remain in contact. That is the only mystery. If adhesions occur, that explains everything.

The President.—Dr. O'Dwyer states that if there is an opening in the left pleura the left lung will be expanded once or a number of times by air coming from the other lung by cough or the acts of respiration. Expiration, however, tends to compress the lung. It would act as a means of expansion only in distant parts of the lung, mainly in the alveoli of the posterior parts. If it is so that the lung is expanded by the air from the other lung, I should say that there is always more air in the lung than we have use for. It has been the astonishment of all critics that sufficient air should enter through the small opening in O'Dwyer's intubation tube. This shows that we inhale a great deal more air than we require or have use for. If, for instance, there is an opening in the left chest, and the inspiratory muscles perform their function, the large and small bronchi would be filled to such an extent, and there would be sufficient residual air to fill the other lung, during the inspiratory act, and also during expiration (particularly during a cough). The amount of air inhaled is so unnecessarily large that most of the air we inhale will be expelled absolutely unchanged. That, in Dr. O'Dwyer's opinion, would be a sufficient supply of air and a sufficient way to explain the expansion of the lung.

Dr. O'Dwyer.—It makes no difference how much air there is in the lung, you cannot get it into the contracted lung, because it is held by a considerable force of contraction, and, besides, by the thickening of the pleura. It is a physiological fact that in ordinary expiration the air is compressed to a certain extent, but when you close the glottis and subject the air to a much greater pressure, a certain amount must be forced into the other lung. There can be no inspiratory force that will have any effect on the contracted lung. I claim that there is no other way of explaining the inflation of a collapsed lung except by the mechanical effect of forced expiration.

NOISY RESPIRATION IN CHILDREN.

BY DILLON BROWN, M.D.,
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THIS symptom is a prominent feature of one of the most fatal and dreaded diseases of childhood,—laryngeal diphtheria,—as well as of one of the mildest and most frequent,—spasmodic laryngitis. It is common to many diseases in which the indications for treatment are directly opposed to each other, and it is met with in a certain number of cases in which a fatal result will ensue unless a correct diagnosis be made and the proper treatment carried out. Hence the importance of making a careful examination cannot be overestimated; and this group of diseases includes so many conditions that closely resemble each other that it is of the greatest necessity to arrive at the diagnosis by exclusion.

In the great majority of cases this symptom is caused by some obstruction during respiration to the free passage of air through its natural channels. This may be the result either of disease or foreign bodies in the air-passages, or of changes in the neighborhood of them, which produce pressure either upon the nerves or upon the air-passages themselves. It is true that we meet a stertorous respiration in some cerebral lesions, a moaning expiration in pneumonia, frequent sighing and irregular breathing in tubercular meningitis, a short grunting respiration in vertebral caries of the dorsal and lower cervical region, and a loud blowing sound when there is a direct opening into the larynx or trachea; but there should be no difficulty in excluding these diseases, as well as those cases of slight nasal obstruction which produce snoring during sleep. There is no excuse for confounding a pneumonia with croup, and it can only be the result of a very careless examination, although the diagnosis may be very obscure if the child is moribund when seen for the first time.

Hysteria is apt to simulate a great variety of diseases, and often gives rise to much difficulty in diagnosis. Its manifestations are so varied that it is only after a careful study of the symptoms of actual disease that a correct opinion can be formed. Hysteria invariably overacts its part and there is a tendency to exaggerate subjective symptoms.

NASO-PHARYNGEAL OBSTRUCTION.

Here we get many symptoms which are common to obstruction in the larynx and trachea, in consequence giving rise to confusion. In both forms there is the noisy respiration; the dyspnœa, with recessions of the soft parts of the chest-walls on inspiration; the restlessness, the cyanosis, and other evidences of diminished air-supply; the croupy cough, and the increased frequency of the respirations. The differential points are the character of the respiratory sound, which is stertorous and rattling, and of the voice, which is clear, although it has a peculiar nasal quality. Other signs, which indicate disease of the naso-pharynx rather than of other parts of the air-passages, are nasal discharge, excoriations about the mouth or nose, fetid breath, deafness, enlarged cervical or post-pharyngeal glands, pain in the pharynx which may extend to the ears on deglutition, epiphora, and epistaxis. The diagnosis can usually be made at once and positively by inspection of the pharynx and the nares, although it may be necessary to combine this with a careful digital examination. Unless this is done, a post-pharyngeal abscess or a tumor or foreign body in the nares might be overlooked. When there is disease in both the larynx and the naso-pharynx, as is not uncommon in diphtheria, it is very difficult to determine which is the chief cause of the dyspnœa.

Scalds can be excluded from the history of the case. In *herpetic angina* the apparent pseudo-membrane is easily washed away, leaving the characteristic vesicles and the resulting ulcers of this disease. It runs a very short course, and may be accompanied by herpes on the lips and elsewhere. The lymphatic glands are not involved, and there is seldom any great obstruction to the passage of air unless the larynx is involved. When the respiration is embarrassed in *syphilis* of the pharynx, it is due either to cicatrices or to gummata, both of which manifestations are easily recognized, especially when viewed in connection with the history of the case. In the ordinary *follicular amygdalitis* the tonsils are not sufficiently swollen to produce a noisy respiration, but in the *phlegmonous* form, with or without suppuration, there may be a loud snoring respiration, accompanied by the most intense dyspnœa. It is an acute disease, marked by great prostration, and begins with a chill or convulsion and high fever. The tonsils are swollen and red, and this condition extends to the neighboring soft parts, —the uvula, the soft palate, and the pillars of the fauces. In some cases the swelling is enormous. The breath is fetid, due to the decomposition of retained epithelial structures within the recesses of the tonsils; there is pain in the pharynx, which shoots up into the ears on deglutition; and there is more or less deafness, which is caused by extension of the inflammation to the Eustachian tube, rather than by pressure upon it. The voice has a peculiar nasal twang which is very characteristic, and the pharynx soon becomes filled with secretions, which interfere with both respiration and articulation. Glandular enlargement may be present, as well as albuminuria, which occurs in many catarrhal conditions with fever in children. The differential diagnosis between this disease and *diphtheria* depends upon the presence or absence of pseudo-membrane, and there is usually no difficulty in separating the two conditions when fully developed. There may be great difficulty in making an accurate and complete inspection of the pharynx, especially in infants; and the appearances may be masked by the accumulation of a large amount of secretion, which may prevent a good view of the mucous membrane, or may simulate a fibrinous exudation. It may be necessary to wash out the pharynx and free its surface of this mucus and other material before a positive diagnosis can be made.

Retro-pharyngeal abscess can be distinguished without difficulty if a careful digital examination is made, the soft, doughy feeling of the posterior wall of the pharynx being very characteristic. Even inspection may show a swelling in this location, protruding up between the soft parts, and when this disease has been overlooked it is because it has not been thought of on account of its comparative rarity. It is more common during the first year of life than at a later period, and may be due to vertebral caries, nasal disease, tuberculosis, or syphilis; or it may follow scarlet fever, diphtheria, measles, and erysipelas. Constitutional disturbances will be absent if it is the result of a chronic process. Its characteristic symptoms are pain on swallowing or on pressure on the larynx and neck; the dyspnœa is increased on lying down, and when pressure is made on the larynx it is subject to remissions; the neck is stiff and often swollen, and the larynx may be prominent or pushed out of its normal position. The obstruction is on inspiration chiefly, although when the disease is well advanced expiration may be also obstructed. The respiration has a peculiar grating or whistling sound. The voice has a nasal quality, but is usually clear, and the cough is dry, hard, and may be paroxysmal, as in pertussis.

The most frequent varieties of *naso-pharyngeal tumors* are the mucous and the fibrous polypi, the latter of which may grow very large and spread in every direction. Among other varieties are the adenoid vegetations, cysts, sarcomata, etc., and their diagnosis must be made by inspection, although a digital examination may be of great assistance. There is reported, besides other rare tumors in this situation, the case of a *meningocele*, which protruded through the nasal roof and hung down from the mouth, having passed through a congenital fissure of the palate. Phlegmons, or tumors of the *tongue*, may obstruct the pharynx, as well as the curious congenital affection called macroglossia. In this latter condition the tongue may become enormously enlarged, in one case measuring six and a half inches in length and ten inches in circumference. It may be so large as to deform the teeth and alveolus, or even dislocate the jaw, and it may project from the mouth far enough to reach the episternal notch. In *cut-throat* in which the attachments of the tongue are severed, in cases of *tongue-*

tie in which the frænum and subjacent muscles are too freely divided, and in complete *anæsthesia* when its muscular attachments are relaxed, the tongue may be turned over into the pharynx and press upon the larynx, causing suffocation.

Foreign bodies of the greatest variety may become impacted in the fauces or lower part of the pharynx, and consequently interfere with respiration, among the most remarkable cases being that of a live catfish which jumped into the mouth of an adult bather during swimming, and became impacted in the fauces. It is said that this is not a rare accident in India.

LARYNGEAL AND TRACHEAL OBSTRUCTION.

Tracheal obstruction unaccompanied by the same condition in the larynx or the bronchi is rare. The calibre of this portion of the air-tract is so great that it requires an intense type of inflammation, or a very large foreign body to seriously interfere with respiration. In the majority of cases a marked degree of stenosis in this location is due either to external pressure or to cicatricial contractions. It is distinguished from laryngeal stenosis by the voice, which is clear, and by the fact that there are no downward movements of the larynx during inspiration, owing to the great elasticity of this tube, which allows considerable motion on itself without displacing the larynx.

The differential diagnosis between naso-pharyngeal and laryngeal disease is usually not very difficult. The characteristic signs of involvement of the larynx are the voice, which is hoarse or absent; the breathing, which, instead of being snoring and rattling, is hard, brassy, and croupy, and with each inspiration there is a downward movement of the larynx. In both the obstruction is solely or most marked on inspiration, but it should be remembered that in a certain small proportion of the cases of laryngeal diphtheria the expiratory obstruction may be the greater, in which case, although the respiratory muscles will be seen to be actively at work, the recessions of the soft parts of the chest-walls during inspiration will disappear, and instead there will be an emphysematous condition of the lungs, and during each expiration the chest will become barrel-shaped and swollen. This expiratory obstruction may be due to enlargement of the bronchial glands, which are situated at the bifurcation of the trachea. It is the bronchial glands which are involved in diphtheria of the larynx. Again, the disease may be confined to the subglottic region of the larynx, and this is especially frequent in ascending croup. In this event the voice will be unaffected, but all the other signs of laryngeal stenosis will be present. The characteristic of these cases is the rapid increase of the obstruction, often proving fatal in a few hours, and before the inflammation has had time to extend to the vocal cords.

A laryngoscopic examination may give brilliant results, and in tumors and in some chronic lesions a positive diagnosis cannot be made without it in a certain number of cases. However, in the great majority of cases this is not only not necessary, but is almost impossible, and may be the means of doing great harm.

The history of the case will exclude the *laryngitis* and *œdema of the glottis,* which is caused by scalds. It results in such an intense inflammation that the mucous membrane is covered with an exudation that closely resembles pseudomembrane. The peculiarity of this type of injury is that evidences of stenosis do not appear until a variable period after the scald, during which interval there is such a complete absence of bad symptoms that the surgeon may be led to believe that the laryngeal tissues have escaped serious harm.

Laryngeal diphtheria is the important disease of the larynx in children. When there is also diphtheria in the pharynx or nares, the diagnosis presents no difficulties. In such cases the presence of a whispering voice or of aphonia, a croupy cough and respiration, and a laryngeal stenosis which is growing progressively worse, positively indicate membranous occlusion. When confined to the larynx, unless membrane has been coughed up, it may be difficult to exclude *stridulous laryngitis,* or false croup, which is a catarrhal laryngitis with superadded spasm. The characteristic phenomena of laryngeal diphtheria are the absence of fever at the onset of the disease; the muffled whispering character or the absence of the voice; the constant presence of the stenosis, which in the beginning is very slight, but grows progressively worse and soon involves both inspiration and expiration; the rough sawing respiration, which is not necessarily very loud; the croupy cough, and the albuminuria, which is so often present without fever. On the other hand, false croup has a temperature of 102° to 105° at its onset, and all the symptoms reach their greatest intensity more quickly and seem more formidable. The attack comes on suddenly, and usually in the night during sleep. The voice is hoarse and loud, the cough is barking and sonorous, the inspiration is accompanied by a loud whistling stridor, while the expiration is comparatively noiseless, and albuminuria is usually absent, although it may be present, as it can in all catarrhal conditions in children. During the intervals between the attacks the voice and cough are croupy, but the respiration is quiet, unless the catarrh has extended to the bronchi, in which case there may be constant obstruction. A *simple laryngitis* is rare in children, except as the result of syphilis. The symptoms are identical with those of false croup, without the spasmodic element, and the diagnosis may depend upon finding other evidences of syphilis, or upon obtaining a laryngoscopic examination. A chronic form, which is very obstinate, may follow measles and the acute diseases of the larynx, but it seldom interferes with the respiration. *Œdema of the glottis* without inflammation is sometimes a symptom of acute nephritis, especially the form which is so frequent a sequel of scarlatina. Usually, however, it is accompanied by some inflammation of the larynx, and is the result of a scald, or it is a complication of one of the acute specific diseases. The obstruction is entirely upon inspiration, and much light may be thrown upon the diagnosis by a digital examination, for, if the finger is trained, the thickened epiglottis and ary-epiglottic folds may be often felt.

Herpes is said to sometimes invade the larynx and embarrass the respiration. The presence of herpes elsewhere may aid in determining its character, but it seems to me that even a laryngoscopic examination would fail to give us a positive diagnosis, except under the most favorable circumstances.

Tubercular laryngitis is rare. It is a chronic disease, and is accompanied almost without exception by involvement of the lungs. The main features are the voice, which is thick and husky, not whispering, as in the adult; the absence of pain, either on pressure or on deglutition; the cough, which is little altered and has no metallic or ringing quality; the hoarse inspiratory stridor, the elevation of temperature, and the presence of physical signs of phthisis in the chest. There are usually ulcerations, which have a characteristic location and appearance, and therefore the laryngoscopic examination is of great value. In *laryngismus stridulus* we get a pure spasm, arising from reflex irritation. It is often associated with rickets, and usually occurs in infants. As soon as the spasm relaxes the breath is drawn in with a crowing or hissing sound, very much like the whoop of pertussis, and the attack is over, or possibly the child may vomit or cry. At the same time there may be spasm in some of the voluntary muscles,—*e.g.*, the fingers may be clinched upon the thumbs and the toes flexed under the feet. The attacks are short, but may be frequent, and during the intervals the child is quiet. There is no fever and no hoarseness.

When a *foreign body* gets into the larynx it may become lodged in the chink of the glottis or in a ventricle, in which latter position it may cause no inconvenience. It is not a rare accident, and includes the most varied list of articles. The most characteristic symptoms are the sudden onset of the dyspnœa, the violent convulsive cough, and the feeling of suffocation, which appear, not at night as in spasmodic laryngitis, but during the day, when the child is awake and at play. The voice is suppressed, the dyspnœa is continuous or with only slight remissions, and there is pain which is located at some fixed point in the air-passages, most frequently in the larynx, but sometimes in the trachea or lungs. The testimony of the parents may throw light upon the subject, both as to its presence and its nature. When the body remains in the trachea it is usually movable, and the only symptoms would be a paroxysmal cough and a peculiar flapping noise heard both at a distance and on auscultation, in the direction of the larynx, which is caused by the movements of the body during respiration. A very unique case is reported by McNamara, in which a whistle made from a plum-stone became lodged transversely in the lower part of the larynx, and gave rise to a whistle as the air passed through it in expiration. The only inconvenience was an occasional suffocative cough. Foreign bodies in the œsophagus may press upon the larynx or trachea, and give rise to the same train of symptoms as when present in the air-passages. The differential points are the voice, which is usually unaffected, although it may be hoarse, and deglutition, which cannot be accomplished without causing pain or producing cough and regurgitation of the food through the nose and mouth. The œsophagus may be explored by a bougie, and in some cases a foreign body may be detected even with the finger.

Tumors of the larynx and trachea are usually polypoid, although many other kinds are met with in this location,—papillomata, fibromata, cystic tumors, myxomata, lipomata, angiomata, and sarcomata. They are of slow growth, and the voice is affected for a considerable time before the breathing. They are easily distinguished from the acute diseases of the larynx, but an examination with a mirror is absolutely necessary for a differential diagnosis between each other.

There is a large number of diseases which interfere with respiration by *external pressure* upon the air-passages, and their most characteristic symptom is an increase of the dyspnœa when in the horizontal posture. Retro-pharyngeal abscess and tumors and foreign bodies in the œsophagus have been considered. In *suppuration about the larynx* the symptoms simulate a retro-pharyngeal abscess,—the orthopnœa, the rattling, stridulous inspiration and comparatively noiseless expiration, the voice and cry hoarse, the cough rough but without clangor, and the pain on deglutition with possibly the return of the food through the nose and mouth. It differs from the fact that no pharyngeal swelling can be detected even by the finger; the larynx may be prominent or pushed out of the mesial line, and there is some swelling in its neighborhood, which feels more as if it contained air than fluid. It is an acute disease and runs a short course. External pressure upon the air-passages may be made by any of the following diseases, but their diagnosis presents no special difficulties: erysipelas and phlegmons of the neck from various causes; cervical tumors; tumors and phlegmons in the posterior mediastinum; enlarged lymphatic glands; aneurisms; and tumors and hypertrophies of the thyroid gland and of the thymus gland. This may also occur in *dislocation of the clavicle* backward at the sterno-clavicular joint, which may be the result of violence, or has occurred spontaneously in connection with the chest-deformity of vertebral caries and of rotary lateral curvature of the spine. In *empyema* the trachea may be so greatly obstructed that both expiration and inspiration is impeded. This occurred in a patient of Dr. Joseph O'Dwyer's, which I had the pleasure of seeing. Both respiratory sounds were loud and croupy, and there was extreme dyspnœa. All these symptoms immediately disappeared upon removal of the pus from the chest, and the child made a good recovery.

Pressure upon the pneumogastric or its recurrent branch by enlarged bronchial glands is characterized by spasm, but is always preceded by some time by hoarseness and paroxysmal cough. Dr. J. Solis-Cohen says that the epiglottis is apt to be incarcerated in the larynx during the most violent paroxysm of spasm of the glottis, and that suffocation may be thus produced. It can be detected by a digital examination. The peculiar hiccoughy respiration of *chorea of the larynx* and the loud whooping inspiration of *pertussis* require only to be mentioned.

In *fracture of the larynx* the history of an injury may give valuable aid, but a positive diagnosis can be made only when crepitus and motion of the fragment is detected. An examination should always be made with the finger passed over the dorsum of the tongue. Locally there is severe pain on pressure, and swelling due both to emphysema and infiltration of blood and serum. Ecchymoses may appear. This injury is associated with great pain on speaking, on swallowing, on moving the tongue, and on opening the mouth. The articulation is indistinct and the voice may be hoarse or absent. There is marked dyspnœa, which is increased on protruding the tongue, and death may be due to suffocation. If the mucous membrane be pierced by one of the fragments, there will be a hemorrhage and bloody expectoration. In *paralysis of the abductor* muscles of the glottis, inspiration only is obstructed. It is almost exclusively a sequel of diphtheria, and in young children may produce asphyxia in a very short time.

OBSTRUCTION IN THE BRONCHI.

In the respiratory diseases located in the bronchi and in those which cause pressure upon the bronchi there is, as a rule, greater obstruction to expiration than to inspiration. Again, the respiratory sound is diminished only on the side to which the obstructed bronchus goes, while, on the other hand, when the obstruction is above the bifurcation of the trachea, the respiratory sound, although diminished, is of equal intensity on both sides.

The wheezing respiration of some forms of *bronchitis* and *œdema of the lungs,* which can also be detected by placing the hand on the back, should be easily made out. *Chronic emphysema* is very apt to be accompanied by a wheezing breath-sound, a husky cough, and attacks of dyspnœa which are asthmatic in character. This emphysema is more probably the result of the asthmatic attacks, which in children, almost without exception, are not primary, but depend upon other conditions, in most cases a chronic interstitial pneumonia or enlarged bronchial glands. The chest is distended in the upper regions, and there is hyper-resonance on percussion. The area of cardiac dulness is diminished, and the liver may be displaced.

There is both an *acute* and a *chronic membranous bronchitis,* and when confined to this location a positive diagnosis can be made only when bronchial casts are coughed up, although, when the membrane becomes loose, a peculiar squeaking or flapping respiration is heard.

In *spasmodic asthma,* which in the pure form is rare in children, there is marked dyspnœa during the attack, and it is characterized by an excited action of the muscles of respiration, with heaving of the chest; but the obstruction is on expiration, and the recessions of the soft parts of the chest during inspiration are absent, and the chest remains fully distended and moves but slightly during each breath. There is a marked spasmodic element, and the severity of the suffering is out of all proportion to the physical signs. The expiration is prolonged and laborious; there is but little increase in frequency of the breathing; there is no laryngeal stridor, and the temperature is normal. The cough is short and dry, but not paroxysmal. It is often the result of whooping-cough or catarrhal pneumonia; the child usually suffers from pulmonary emphysema, and the attack occurs as a consequence of a fresh catarrh. There are very few cases in young children in which direct pressure upon the bifurcation of the trachea or a main bronchus can be excluded.

Enlargement of the bronchial glands is not rare, according to Eustace Smith. These glands are situated at the bifurcation of the trachea, behind the upper bone of the sternum and a little below it, and also accompany the bronchi into the interior of the lung. They may cause considerable disturbance by pressure upon the blood-vessels, the air-passages, and the nerves of the chest. Evidences of pressure upon the vena cava or either innominate vein is shown by some lividity of the face, epistaxis or hemorrhage from the lungs, and prominence of the superficial veins of the temples, neck, and front of the chest. This pressure causes a venous hum, and, if the glands are not sufficiently enlarged to press upon the vein, it can be induced by throwing the head backward, if the glands are movable. Pressure upon the nerves is shown by hoarseness and a paroxysmal cough which resembles pertussis. Pressure upon the trachea produces a more or less spasmodic dyspnœa, which may be intense, occurs most frequently at night, and usually follows a catarrh or cold. There is an expiratory stridor, which is generally intermittent. When the glands are in contact with the chest-wall there will be dulness over the first bone of the sternum, which may extend for some distance on each side and below. Auscultation gives a very characteristic loud, blowing sound, produced by transmission from the bronchi through the glands. It is most marked at the apices of the lungs, although it may be heard loudly over the whole of one or both sides of the chest. It is less high-pitched and metallic than the sound heard in cases of pulmonary consolidation and excavation, and upon opening the mouth it is generally modified in intensity or may disappear entirely.

When a *foreign body* gets into the bronchi there is usually a sudden attack of dyspnœa and spasmodic coughing, and there may be periods of comparative comfort between the paroxysms. It is marked by expiratory obstruction, a fixed pain referred to some part of chest, often an inability to lie upon one side or the other because it increases the dyspnœa, and a cough which resembles pertussis, and may be accompanied by a peculiar clicking noise. The respiratory murmur is diminished or suppressed upon one side, and the physical signs are those of collapse or surgical emphysema. It may result in a catarrhal pneumonia, gangrene of the lung, or a chronic phthisis.

DISCUSSION.

Dr. J. Henry Fruitnight.—I wish to emphasize the significance of hoarseness of the voice to which the author has alluded. I regard hoarseness, and even huskiness of the voice in children, as a warning of danger. In my experience it is often a premonitory symptom of impending serious laryngeal stenosis, and hence the physician should be on the alert, when it is present, lest by inattention the patient might develop a possibly fatal attack of laryngitis.

Dr. A. Caillé.—Dr. Brown has mentioned most of the causes of this condition, but he has not referred to acute pulmonary œdema. In some forms of heart-disease we may have acute œdema, which develops within five or ten minutes, giving rise to very characteristic noisy respiration.

Dr. Francis Huber.—I should like, in this connection, to mention the case of a child six or seven years of age, to which I was called to intubate. The child had received about eight grains of iodide of potassium in the course of a few hours. The stenosis was sufficient to be quite alarming. There was also considerable coryza and swelling of the eyelids. I advised delay, and in a short time the stenosis grew less and disappeared in about three days. In this case the child was extremely susceptible to the action of iodide. Partial swallowing of the tongue is not at all infrequent. I have seen three instances in children much run down, and who when allowed to rest on their back would have considerable difficulty in breathing. When the children were placed on their sides the difficulty at once disappeared.

Dr. W. L. Carr.—I might mention the case of a young girl admitted to St. Mary's Hospital who had marked hysterical manifestations. She had very noisy expiratory sounds, and was very troublesome for a time. If spoken to sharply, the noise would cease, but would soon begin again. She finally did well under the use of arsenic. This case was regarded as a case of localized chorea involving the muscles supplied by the recurrent nerve.

GENERAL SUBCUTANEOUS EMPHYSEMA.

BY CHARLES WARRINGTON EARLE, M.D.,

Chicago.

On the 26th of November, 1888, through the kindness of Dr. R. H. Kenning, I was called to see Homer Jones, aged three and a half years. He was, and had been for one week, very sick with catarrhal pneumonia. This pneumonia was not, as is frequently the case, secondary to any disease, but had developed as an ordinary cold, until finally it culminated in the disease with which I found him suffering. It is of course possible, perhaps I should say, in view of subsequent events, entirely probable, that there was a little pleuritic complication. But there was no effusion of any consequence, and, even if something of a pleuritic nature had existed, the treatment would not have been changed. The boy progressed satisfactorily, without material change in treatment on my part, till December 10, when I was hastily summoned, with the intelligence that the little patient was enormously swollen.

Upon visiting the case I found that the urgency of the call had not been exaggerated. The subcutaneous tissues of the forehead, cheeks, neck, and of the entire trunk anteriorly to Poupart's ligaments, and posteriorly to the iliac crests, were filled with air.

The child looked as if he would float on water. The respirations were hurried, the pulse moderately rapid, and the face, in addition to its peculiar appearance, had a worried and anxious look. It was not at all difficult to see that we had here a case of very general subcutaneous emphysema. It made its appearance in the neck at first, and rapidly extended to every other part of the body except the scalp and legs. I had never seen anything comparable to it before. I had noticed a local and always insignificant emphysema after two or three tracheotomies and in a few surgical cases, more particularly in the extremities. A few trivial cases, always local, had engaged my attention, but nothing compared with this.

Acting entirely upon my own judgment, and without precedent, I bandaged the child from its feet to its chin, and administered a stimulant and supporting treatment. The child at times seemed to improve, but at last began to show signs of exhaustion, and died on the tenth day after the appearance of the complication.

The propriety of puncturing the skin in different places was discussed, but it was thought that it would add an additional danger,—the possibility of infection,—and the measure was not employed.

I must now add, with deep regret, that no autopsy could be obtained. Every argument possible which was at all honorable was brought to bear on the mother, but to no avail; under no circumstances would she allow it.

And now, what is the state of our knowledge concerning this disease, or this complication of other diseases. We shall find that the majority of text-books on diseases of children are remarkably silent regarding the subject. Although Latour, in his "Manual on Croup" (1808), mentions a case of great dyspnœa in a child, caused by a rupture between two tracheal rings, it is not clear that emphysema followed. But it is cited in close relation with Bourgeois's observation, which is directly to the point. In the case of a girl, twelve years old, on the seventh day of croup, there was heard, after a violent attack of suffocation, a noise in the breast of the child, as if a rupture had taken place. After this, emphysematous swelling and death followed, but no rupture in the bronchial tubes could be found at the post-mortem. Rauchfuss says a less frequent, and in its extreme degrees very rare, sequela of stenosis of the upper air-passages is interlobular and subpleural emphysema, which may spread as mediastinal and subpleural emphysema, and finally into the subcutaneous variety.

Steffen, to whose works I have not had access, has probably written as voluminously as any author upon the general subject of emphysema. Whether he speaks to any extent regarding the variety we are considering I do not know, but probably not, as in another part of my paper it will appear that only three or four cases of complete subcutaneous emphysema from lung complications have ever been recorded. He, however, does cite one case caused by a foreign body (a bean in the bronchi), which subsided after the latter's expectoration.

Fürst (Gerhardt's "Handbook") goes over the entire field of all forms of the disease we are considering, but says little concerning the subcutaneous variety, except that it may occur from rupture of the alveolar variety,—becoming subpleural, then mediastinal, and then subcutaneous. All the arguments for and against emphysema being a disease in itself are carefully considered, and the various theories as to its etiology and pathological anatomy brought out.

It is only during the last half of the present century that particular reference to emphysema as a children's disease has been studied. Perhaps the most important fact established is, that in children an ordinary or vesicular emphysema is more amenable to treatment than in adults. The pathological condition is not so pronounced. In adults the elasticity and rarefaction of tissue is plainly marked and the prognosis unfavorable, while in children, with the removal of the cause, recovery is to be expected. Lung-tissue in children has not the tendency to atrophy that we find in adults. There are those, however, who believe that from the yielding alveolar and thoracic walls of children these subjects are extraordinarily predisposed to the different forms of pulmonary emphysema. Steffen particularly places great importance on this point.

Although it is confessed by all authors that subcutaneous emphysema is very rare, yet as a form it finds its place in the best classifications.

Fürst's classification is as follows:

1. Vesicular or alveolar,—alveolar or infundibular.

2. (*a*) Within the pleura: interstitial, interlobular, subpleural. (*b*) Without the pleura: mediastinal, peribronchial, subcutaneous, involving the thorax, neck, and face, and in some cases becoming general.

To this might be added those emphysemata which may arise as complications or sequelæ to other diseases, or more particularly to surgical operations. In this class we will find our cutaneous form, particularly the partial variety, with greatest frequency.

With all these varieties of emphysema it would be expected, perhaps, that our standard authorities on diseases of children would at least mention the pulmonary forms. The excuse may be given—and I do not criticise their judgment—that it is such a rare disease that it hardly merits the space necessary.

The following authors on pediatrics, to whom I have easy access, say absolutely nothing regarding subcutaneous emphysema,—viz., Starr, Jacobi, Steiner, Meigs and Pepper, Hillier, Day, Ellis, Goodwin, Owen's "Surgical Diseases," Stewart, Gooch, Dewees, Underwood, Eberle, Goodhart, Henoch, Duncan, Meadows, Smith, West, Barthez, and Ralliet. I find nothing in four or five volumes of the Archives of Pediatrics. Condie, however, speaks of a case in which everything was favorable for a cutaneous emphysema, but whether it was produced he does not say. A child swallowed a metal button, which lodged in the right bronchial tube. In the course of a few weeks it developed pneumonia in both lungs, which was followed by subpleural emphysema. From Vogel, who evidently was acquainted with the disease under consideration, I quote the following: "Sometimes they (air-bubbles) circumscribe a pulmonary lobule, in the shape of an island, and, when the interlobular emphysema has developed itself between many neighboring lobules, form large air-bubbles, which may be pushed hither and thither over extensive portions of the pleural surface of the lung. The escape of air into the connective tissue surrounding the bronchi into the mediastinum anticum, and thence out upon the neck and breast, is a very rare occurrence. These instances almost invariably terminate fatally."

From Pepper ("System of Medicine") I find the following: "Emphysema, from the presence of air in the connective tissue, under the skin, is rarely met with, except as the consequence of an injury or of local gangrene."

Fraentzel, in speaking of the treatment of pneumothorax (Ziemssen, vol. iv., p. 770) by capillary puncture, says, "If we are not careful about this, then air passes out of the pleural cavity in coughing, enters the canal made by the puncture, and thence passes into the subcutaneous connective tissue. The cutaneous emphysema which is thus produced sometimes spreads with remarkable rapidity over the greater part of the body, and proves most distressing to the patient."

In this connection we quote the following case from *The Lancet*, February 2, 1889. A child, eighteen months old, had broncho-pneumonia. Aspiration was attempted, followed in two hours by subcutaneous emphysema. In eight hours it reached its maximum, involving the whole trunk, but not the arms or legs. It completely disappeared in two weeks. About two weeks later the child died unexpectedly from diphtheria. In relation to the emphysema, the autopsy showed that the aspirating needle had probably entered one of the dilated tubes; consequently, as the two pleural surfaces were firmly adherent, and the walls of the dilated bronchus rigid, a track was left leading direct from the main air-passages to the subcutaneous tissues, into which air was easily pumped by the slight cough that followed the puncture.

In Rokitansky there is the general statement that cutaneous emphysema may follow perforation of the larynx by ulcers, and Wilks reports a case. A boy, twelve years old, with typhus, had an emphysematous swelling on his neck on the twelfth day, which spread over his face, breast, and arms. Death followed in ten days. Post-mortem revealed perforating laryngeal ulcer.

In the chapter on "Rupture of Œsophagus" (Ziemssen, vol. viii., p. 94) occurs the following sentence: "In a diagnostic point of view a very important symptom is the almost constant appearance of a rapidly-developed emphysema of the skin, which, appearing first on the neck above the clavicles, soon extended over a large area, and sometimes involved the whole surface of the body."

Subcutaneous emphysema may occur as a consequence of gastric ulcer. The gas is generated in the stomach, and contains hydrogen, as it burns with a blue flame. The gas may enter the subserous tissue at the edges of the ulcer and thence spread, or, after perforation of the stomach, it may make its way from the peritoneal cavity into the loose subserous connective tissue through some place in the parietal peritoneum which has been macerated, perhaps, by the digestive action of the gastric juice.

Professor Welch (Johns Hopkins University) brings this out fully in his article in Pepper. He gives to Roger the credit of first calling attention to this fact, and cites a number of authorities who may be consulted, if one wishes to investigate the subject further. (Pepper, vol. ii., p. 509, foot-note 3.)

Regarding the local emphysema which sometimes takes place after tracheotomy, E. Bartel believes that it is due to the sudden and forcible entrance of air into the alveoli subsequent to stenosis when the tracheotomy is performed, vesicular emphysema being produced first, then interlobular, mediastinal, subpleural, and then cutaneous. Rauchfuss believes the emphysema complicating tracheotomy is due to air entering the cellular spaces through the wound from without, and he has known it to occur before the trachea has been opened. The order in which the disease takes place is generally conceded to be, first, interlobular; second, subpleural, and extending to the base of the lung; then mediastinal, followed by intermuscular, and then subcutaneous.

Dr. Baudey, of Lille, speaks of emphysema of the eyelids and orbit, in which the air in the nasal fossæ passes into the cellular tissue. Emphysema in this location taking place after an effort in clearing the nose or sneezing is usually the result of a fracture of one of the bones in the internal orbital wall. Under certain circumstances a so-called spontaneous emphysema results from rupture of the nasal duct, produced by surgical traumatism. In such a case a fracture is not necessary. In very rare cases this form of emphysema is attendant upon defective developments of the parts in question.

A peculiar case of traumatic emphysema is reported by Paucin. He found a considerable swelling of a portion of the thigh, the scrotum, lumbar region, and lower part of abdomen, in a laborer, who said that, in punishment for some supposed injury done to them, two of his companions held him, while a third made a small incision in the inner surface of the prepuce, introduced a small tube into it, and blew in air. An examination disclosed a small ragged wound three millimetres in length at the point indicated.

Dr. Luoff reports three cases of emphysema occurring during labor, one of which came under his observation.

A few cases of general cutaneous emphysema are on record following abdominal section.

Prof. H. M. Lyman narrates the following important case: "A man, aged forty-five, in a drunken fight, was kicked in the trachea with the toe of a heavy boot. Was seen the following day, and found to be emphysematous to the groins. No other very marked symptom. Gradual recovery. The swelling and crepitation entirely disappeared without active treatment in the course of a few days."

Perhaps the most interesting case on record of cutaneous emphysema is found in *Archiv f. Kinderheilkunde*, vol. viii., 444, by Dr. Franz von Torday, university of Budapest. A three-year-old boy, well developed for his age, was taken ill with diphtheria of both tonsils on November 6, 1883. His parents were healthy, but the hygienic surroundings were not the best. The treatment consisted in soda salicylate internally, and iodoform and glycerin locally. On the fifth day symptoms of laryngeal invasion were present, and there was evidence that the lungs were becoming congested to an alarming degree. His weakness was also increased by a severe diarrhœa of a watery character. In spite of the most careful nursing and treatment the patient continued to grow worse. Professor Bakai, in consultation, pronounced the case unavoidably fatal in a few hours, as the stenosis had reached the highest possible point, respiration being confined to the upper portions of the right lung, where even it was mingled with rattling and piping sounds. At 9 P.M. the patient was comparatively quiet, resting with outstretched neck in a semi-recumbent position in its mother's arms; lips cyanotic, extremities cold, face and trunk covered with perspiration, and eyes dim. November 13 I called on the family, expecting to find the child dead; to my great surprise I found him asleep, sitting in a vapor-bath. Respirations 40 to 50 per minute and the pulse a little faster, 160 to 180, but also stronger. Breathing and piping sounds could now be heard in the upper portion of the left lung, not lower than the fifth rib, but not in the lower portion of the right lung.

On the right side, between the vertebral border of the scapula and the spines, there was a triangular swelling, size of a hen's egg, soft, elastic, and cushion-like to the touch. The edges of the swelling were puffed out, and the skin covering it showed scarcely any change in color or consistency. No one had noticed the appearance of this subcutaneous emphysema.

During the following twenty-four hours there was no material change in the disease. But the subcutaneous emphysema quickly spread over the right side of the neck towards the front. It progressed so rapidly that already, on the first day, it had so far covered the face that the eyelids, especially on the right side, had swollen into small cushions, and completely covered the eyes. The emphysema then went to the head, and during the following three days it invaded the chest, back, arms, and hands to the finger-nails, and the trunk to the pelvic bones.

The external medication was continued and inhalations of bromine vapor ordered. Nothing was given internally, because it was refused. Therefore quinine was injected in clysters of strong beef-broth and yolks of eggs. From November 14 to 17 the temperature hardly rose above 38° C. On the 17th improvement began. Retrogression of the emphysema was constant, uniform, and lasted eight days.

November 28, emphysema had entirely disappeared. Respiration remained harsh for a time, but in a month's time the respiratory organs were restored to their normal condition. It took a year, five months of which were spent in the country, to dispel the hoarseness.

This case is interesting on account of the severe subcutaneous emphysema which nearly covered the whole body, and therefore may be called complete. There is scarcely a doubt that the origin of the emphysema was from rupture of the pleura at the root of the lungs. The rupture was the result of increasing diminution in respiratory surface, associated with forced breathing and spells of violent coughing. The air escaping from the lung entered the posterior mediastinum, and rapidly dissected its way upward into the more open connective tissue, and then under the skin.

So severe and almost complete subcutaneous emphysema, under circumstances like those related above, occurs comparatively seldom in children, and in most cases has a fatal termination. The possibility of the occurrence of subcutaneous emphysema is sometimes alluded to in text-books and periodicals, but I have found only a single case in the literature of the profession which was observed and thoroughly presented. This case, observed by Sachse (*Virchow's Arch.*, lii., p. 148, 1871), seems very much like mine. Here, too, pharyngeal diphtheria was the existing disease. Under treatment the breathing became easier, and yet on the fourth day there appeared subcutaneous emphysema, which spread over the neck, face, and thorax, ending fatally on the second day. At the post-mortem the anterior mediastinum was found distended with air. The upper portions of the lungs were in a high degree emphysematous, while the lower portions were in a condition of acute inflammation.

I have not found another case in literature where so widespread emphysema followed diphtheria, or where it was attended with diseases of the lungs.

Monti (*Jahrb. f. Pädiatrik*, 1872, ii.), Steffen (*Klinik d. Kinderkrankh.*), Fürst, Hertz, and others, who have thoroughly studied emphysema of the lungs in children, are generally of the opinion that subcutaneous emphysema in children is very rare, and when found, results from catarrhal pneumonia, capillary and croupous bronchitis, and especially pertussis. In these cases the air passes from the lungs through the ruptured interlobular connective tissue into the mediastinum, and thence to the neck and under the skin. In most cases the disease has been fatal.

Recapitulations.—Subcutaneous emphysema is either local or general. As a local difficulty it is found after operations in the vicinity of and involving the respiratory tract. It occurs after tracheotomy, and by some writers is believed to take place before if the stenosis is very pronounced. It may follow puncture of the chest in the treatment of pneumothorax, and is found around and involving the cellular tissue of the eyes, caused by exaggerated expiratory efforts, producing a fracture of one of the bones in the internal orbital wall, or from rupture of the nasal duct. A local emphysema may also be produced by the introduction of air through a tube into loose subcutaneous tissue.

General or complete subcutaneous emphysema is rare in children; and from the fact that the causes which produce it in the young are generally not present to the same extent in adults, we may conclude that this form of emphysema is very rare among those who have reached advantage.

The etiology of subcutaneous emphysema in children is interference with or obstruction to respiration, as we find it in catarrhal pneumonia, capillary bronchitis, pertussis, croup, and diphtheria. It may arise from perforating laryngeal ulcerations, from rupture of tracheal rings either by force or the results of disease, from rupture of œsophagus, and as a consequence of gastric ulcer.

The prognosis is good, unless the preceding disease has brought about great depression and asthenia. In weak children, with a grave malady which in itself taxes the recuperative faculties of the system, a fatal result may be expected.

Treatment.—Nature sometimes effects a cure by a circumscribed pleurisy or by a gradual narrowing in the opening. The means at our command are limited. What surgery will do in the future for its relief is not at this day known. We should puncture the skin in the most prominent emphysematous places, using every antiseptic precaution, bandage the body in the most complete manner possible, and sustain the strength and vitality of the patient by every means at our command.

DISCUSSION.

Dr. Francis Huber reported the case of a child eighteen months old, in which general emphysema followed a low tracheotomy. Death about twenty hours later. In another case emphysema followed immediately on the withdrawal of the needle in a case of aspiration. Was positive that the lung had not been injured, for the needle moved freely in a cavity, and over a pint of pus was readily drawn off. An incision was then made into the pleural cavity and a drainage-tube inserted. Three days later a slough of lung-tissue came away.

The case ultimately made a good recovery. When a small opening is made in empyema there is danger of localized emphysema occurring, necessitating the enlargement of the incision to prevent the air infiltrating the connective tissue.

Dr. J. Henry Fruitnight had not met with this accident in children, but gave the details of a case occurring in an adult, in which the ends of a fractured rib punctured the lung and was followed by emphysema of the thorax on the left side.

The President had seen several cases, but none so extensive as that reported by Dr. Earle. Some occurred in tubercular phthisis with pneumothorax; many in cases of croup. Most of these were antefacts, that is, the emphysema was the result of a lesion of the mediastinal connective tissue, when tracheotomy was performed below the thyroid. Most of these cases were seen in his early practice, and were avoided in later years. A spontaneous case of emphysema during the intense dyspnœa of croup was relieved by tracheotomy, which freed the mediastinum of its emphysema, or rather prevented its increase.

Dr. Earle asked why the emphysema always stopped at Poupart's ligament. Why not puncture in several places?

Dr. W. L. Carr thought that the limitation of the air above Poupart's ligament was due to the peculiarity of the attachment of the fascia at that point. The deep layer of the superficial fascia is bound down by a thin but dense intervening layer of fibrous tissue along the whole length of Poupart's ligament.*

Dr. Francis Huber, in considering the propriety of puncture in emphysema, would be guided by the indications of the individual case.

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* "Quain's Anatomy," eighth edition, vol. i. p. 314.

MEMBRANOUS CROUP (LARYNGO-TRACHEITIS) IN A GIRL TWELVE YEARS OLD—TRACHEOTOMY—RECOVERY.

BY A. CAILLÉ, M.D.,
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On July 1, 1889, I was requested to intubate in a case of laryngeal stenosis. I found my patient, a girl of twelve, sitting upright in bed, with moderate dyspnœa, slight cyanosis, rapid pulse. Temperature, 100° F. Cool and pale skin. Submaxillary gland could be felt on both sides; there was no visible membrane in the nose or pharynx, and the mucous membrane of the pharynx was unusually pale. The patient's voice was husky, and a short, dry, croupous cough could be heard every few minutes. Palpation with the index-finger revealed a stiff and thick epiglottis and a marked flattening of the funnel-shaped laryngeal entrance. It was reported by the parents of the girl that she had been under treatment for eight or ten weeks for chronic laryngeal catarrh, that two cases of diphtheria had developed in the same house, and that the girl had been removed to her present quarters to avoid complications.

An examination with the laryngoscope was attempted, with unsatisfactory result, owing to the marked dyspnœa. As a result of our careful examination, I did not hesitate to corroborate the diagnosis of the attending physician, who had pronounced it a case of membranous croup, which is quite rare at the age of twelve.

Operative interference was postponed because the dyspnœa was not urgent, and because it is not unusual for older children to recover after mercurial treatment and proper inhalations. Minute doses of bichloride of mercury were ordered every half-hour in a watery solution containing a small dose of wine of ipecac. A continuous spray containing eucalyptol-turpentine was kept up during the night.

At six o'clock the following morning a choking spell set in, and a piece of membrane was coughed up, somewhat thicker than blotting-paper, three inches in length and half an inch in width, smooth on one side and sanguineous on the other.

Auscultation showed little respiratory murmur in the left lung. During inspiration a short "flap" sound could be heard, which I believed to be due to a partly-detached membrane. There was good murmur in the right lung.

After the expulsion of this membrane respiration became very free, and the girl asked for food. Towards noon the same day the stenosis became urgent, and at 3 P.M. I performed tracheotomy for its relief. The thyroid gland was found large and located high; the original incision was then carried downward, and the trachea opened below the thyroid gland, with a view of affording the greatest possible access to the lower trachea. After opening the windpipe the latter was illuminated by means of a head-mirror, and the thick membranous lining removed from above and below the line of incision. Good breathing was at once established, and a large-sized tube finally introduced. On the day following the operation the body temperature rose to 102°, 103°, 104° F., and this febrile condition persisted for a week. During this time expectoration was at times profuse and at other times it ceased completely. A continuous spray was absolutely necessary to insure comfortable breathing, a salt-water spray being the most acceptable to the girl, who was intelligent and a good observer of her condition and symptoms.

Sudden and severe attacks of dyspnœa came on several times each day, due to obstruction by membranes or thick mucus in the lower trachea. These choking spells were so distressing that it became necessary to drop salt water directly into the trachea in quantities of ten to twenty drops at a time and at regular intervals. By such means the membranes were loosened and expelled, and several hours of good breathing secured. On three occasions during the night I was obliged to remove the tube and await the expectoration of an obstructing membrane before reintroducing it. This bottle contains some of the membranes thus expelled.

After a week of anxiety as to the final result, the temperature became normal, and the expectoration became thin and slightly sanguineous. Good breathing was established in both lungs, with abundant moist râles. On the tenth day the temperature rose again to 103° F., marking the onset of a purulent bronchitis, which lasted a week. The tube was removed on the fourteenth day, and two weeks later the somewhat large and gaping wound had closed, and the girl passed from my observation in good health, with a perfect respiration and slightly husky voice.

In closing this report I would state that I have operated sixty-five times for laryngeal stenosis in children under seven years of age, and that this is the first time I have observed a membranous stenosis in so old a child. In choosing between the two operations, tracheotomy and intubation, I chose the former as affording, in my opinion, the best chances of success in so grave a case, in which the symptoms before operation pointed to the probability of massive membranous deposits in the lower trachea,—a well-founded supposition, as shown by the subsequent experience in the case.

DISCUSSION.

The President said that the disease was rare at this age, and that he had operated only once on such a case. The girl was thirteen years old, and died some weeks after the operation of general sepsis and gangrenous destruction of a large part of the anterior wall of the trachea.

Dr. J. O'Dwyer remarked that tracheotomy should be tried when intubation fails. In an experience of two hundred and fifty intubations he had performed this operation on two children of this age.

Dr. Francis Huber.—The oldest child intubated was eleven years of age. He advised the use of a smaller tube, as each expulsion of the tube is followed by casts. In fact, would resort to "intermittent intubation," a plan advocated in an article which appeared in the Archives of Pediatrics in January, 1889.

Dr. Dillon Brown said that it was, in some cases, easier to remove loose pieces of membrane after intubation than after tracheotomy. The O'Dwyer tube not only acted as an irritant but enabled the patient to obtain a more expulsive cough than tracheotomy did. He related a case illustrating this point, and referred to a number of cases in which more than one piece of pseudo-membrane had been expelled through the natural air-passages after intubation. In one case there were seven complete casts coughed up, many of them having one or more branches.

Dr. H. N. Vineberg asked what the object was of intubating when the stenosis was in the trachea and bronchial tubes. If the tube in the larynx merely excited expulsion of the membranous casts of the trachea and larger bronchi, would not some other simpler method of intubation be just as efficacious?

The President would have done as Dr. Caillé did. He had been converted to a belief in the value of intubation, but where the membrane was below and where the croup was ascending tracheotomy should be employed. He recalled twenty or thirty cases of fibrinous bronchitis terminating in diphtheritic tracheitis and laryngitis. In these cases, when this ascending form of croup reaches the larynx, cyanosis sets in very rapidly, and as a rule tracheotomy yields but little relief, if any. Still it ought to be performed, furnishing the only way in which access to the pseudo-membranes can be had.

JANICEPS ASYMMETROS.

BY A. CAILLÉ, M.D.,
New York.

Through the courtesy of Dr. Holcomb, of New York City, I have the opportunity of presenting this monster, which in the text-books is described as a synkephalus. It is formed by the fusion of two bodies. In this specimen it is an asymmetrical synkephalus, having one head, four lower and four upper extremities. The thorax is double; the vertebræ from the pelvis up are double; the umbilicus is single. The viscera have not as yet been examined; but in similar cases, reported in Ahlfeld's book, and pictured on Plate XV., Figs. 1 and 2, the stomach and œsophagus are usually single, the kidneys and genital organs double. The thorax may be single or double, and the thoracic contents in accordance. The cerebrum is usually single; the cerebellum, medulla, pons, and corpora quadrigemina double.

Dr. Holcomb reports that the janiceps asymmetros here presented was a vertex presentation, born without difficulty, and lived a few hours. It was the sixth child of healthy parents, all the previous children being normally developed.

JANICEPS ASYMMETROS.

JANICEPS ASYMMETROS.

THE ARTIFICIAL FEEDING OF INFANTS.

BY ARTHUR V. MEIGS, M.D.,
of Philadelphia.

IN addressing a society the special purpose of whose existence is the study of the diseases of children, no excuse is necessary for having chosen as a subject the artificial feeding of infants. That preventive medicine can accomplish more for the general good than any other branch of our science is a fact which receives almost universal acceptance, and it must be acknowledged that so long as there continues to be any great disagreement among physicians with regard to how infants should be fed, of the various methods chosen, most must be bad, and from their pursuance must result the foundation in the earlier months of life of much disease. It is this diversity of opinion among those who are looked up to as authorities in the community that is most to be deplored, and it is a very hopeful thing to be able to believe, as for my own part I do, that this diversity not only will be, but actually is now being removed, owing to the efforts of scientific men to come to a common understanding of the matter. In endeavoring to reach a conclusion there are, as I have already pointed out in previous publications,* but two possible methods, the one purely empyric, to experiment with various foods until the best is found; and the other, by analysis, or otherwise to learn as nearly as possible what human milk is, which we all know to be the most perfect food for infants, and then to make an imitation of it. It is a most fortunate thing that all knowledge of the subject at the present time, both that derived from the first as well as the second method of investigation, seems to lead towards a common conclusion.

It may be assumed that in civilized countries, at the present time, cow's milk forms the basis of all the different foods which are used for infants, for though there are here and

* "Milk Analysis and Infant-Feeding," by Arthur V. Meigs, Phila., 1885.

there occasionally persons who recommend foods which contain no cow's milk, or even no milk of any kind, yet they are so few that they need not be taken into account. It has been said that both clinical investigation and analysis have of more recent years been leading towards an identical conclusion, and of this any one may be convinced who will turn to the more modern literature. For a long time most students of the subject have advised that, before administering cow's milk to young infants, it should be diluted, and more and more it will be found, as we come down towards the present time, that writers speak of the great advantages to be derived from the use of cream, and at the same time say that sugar should be added to the food. Such have been the results of the labors of practising physicians who have based their conclusions solely upon the effects they have derived from the use of different foods, recommending finally that with which they best attain their end,—the successful rearing of infants by hand. This is what has been learned from clinical investigation of the subject or, as it may be called, the practical study. Now, what have been the results of an approach to the subject from the theoretical stand-point,—of chemical analysis of various foods, and of cow's and human milk in particular? So far as I have been able to learn, there has at no time been any disagreement among chemists in regard to the composition of cow's milk, results which for all practical purposes may be called identical, having been reached by all. When different analyses of human milk, on the other hand, are compared, it is seen that widely-diverging results have been reached. The differences have been in regard to the amounts of casein and sugar present, the estimates of various chemists of the other constituents having been alike. It is strange to notice, and very significant, that however widely the estimates of these two substances (casein and sugar) may differ, the sum of the amounts, if added together, is in every instance almost the same. This is not the time to draw up the figures in array and compare them, especially as I have already fully (loc. cit.) done so elsewhere, but it is remarkable that no one earlier suggested that the great variability presented by different specimens of human milk had no real existence, but was due to faulty methods of analysis. The mean analysis of Vernois and Becquerel has been and continues to be more widely quoted than any other single analysis, and yet their estimates of the various constituents are so nearly identical with the amounts of the different component parts contained in cow's milk that it might well be taken as an average analysis of good ordinary cow's milk.

At the same time that authors quote with approval the analysis of human milk of Vernois and Becquerel, they will state that human milk contains much less casein and more sugar than does cow's milk, never taking into account that the figures quoted directly contradict their statements, and failing to see that the explanation lies in the fact that the analysis is incorrect. More modern chemists, as a general thing, tend to estimate the casein at a less amount; and this is perhaps typified by the statement of Biedert that he accepts as correct the estimate of Vierordt of the casein of human milk at two per cent., but at the same time says that in the artificial feeding of infants not more than one per cent. of the casein of cow's milk must be introduced, because he finds that infants cannot digest it, and this he attributes to the greater degree of indigestibility of the casein of cow's than of human milk. Wanklyn, in his book upon "Milk Analysis," strikes at the root of the subject when he says that within limits milk presents great constancy of composition, and that in this constancy of composition lies the whole basis of the value of milk analysis.

It is now more than seven years since I made the statement* that human milk never contains more than about one per cent. of casein, and that all the analyses, both the older and more modern ones, which estimated its amount as high as three or four per cent., were incorrect—from this statement I have never seen the slightest reason to recede. If this estimate ever comes to receive general acceptance among scientific men, owing to its truth having been so fully proved that no one can any longer deny it, a long step will have been made towards

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* "Milk Analysis," by Arthur V. Meigs, *Philadelphia Medical Times*, July 1, 1882.

improvement in our methods for the artificial feeding of infants, for then, as there will be a good and plain reason why it should not be done, no one will dare to feed young infants upon pure cow's milk which contains three per cent. or more casein. One of the latest utterances upon this subject is to be found in the article upon "Infant-Feeding—Weaning," by T. M. Rotch, M.D., in the "Cyclopædia of the Diseases of Children," vol. i., edited by Keating. In an admirable essay, far in advance in its teachings of anything else upon the subject with which I am familiar, and embodying the results of much study, both from the theoretical and practical sides of the question, the author gives as a standard of the ordinary composition of human milk estimates of the various constituents almost identical with my mean analysis. In another part of the article he gives analyses in which he places the amount of casein as high as two and even four per cent. To me it seems impossible that we can ever place the subject upon a stable basis until it is either proved or disproved whether human milk can ever contain so much casein. From a considerable personal experience in the analysis both of cow's and human milk, I still hold firmly to my statement made years ago, in agreement with Wanklyn, that it is upon the quite near constancy of composition presented by milk that depends the value of its analysis to science. It is to be deplored, therefore, that Rotch did not mention the method by which his analyses were made, and give also the source from which he derived that which he accepts as a standard of the ordinary composition of human milk, for to any one of my way of thinking it is impossible to believe that both his analyses and his accepted standard can be correct.

Since the issue of my first publication upon this subject, I have never had reason to change any of the broader generalities upon which were based the advice in regard to feeding then given. The recommendations were the result of careful study of the subject from both the practical and the theoretical aspects, clinical experience having led me to select a food very nearly like that which I have since arranged; and then analysis having brought me, quite contrary to what my preconceived ideas had led me to expect, to a similar result. It is this agreement of the results obtained both from the practical and theoretical investigations that makes the case an especially strong one; clinical study having led to a conclusion, and then theory stepping in to confirm it and make plain the reason. Experience taught physicians that infants could not digest pure cow's milk which contains three to four per cent. of casein, and chemical analysis gives the explanation—human milk never contains more than about one per cent.

In medicine almost always more weight should be given to the teachings of experience than to the apparent indications of pure science and theory, and yet it has often happened that that which we have learned from practice and clinical study has been confirmed and explained by pure science. Where the two methods led to conclusions apparently contradictory, I should always prefer to abide, provisionally at any rate, by the results of practice. Though, as has been stated, I have seen no reason to make any radical change in my artificial food, which was based upon the dilution of cow's milk, for the reason that it contains too much casein; the further need for the addition of cream, because in diluting the fat was reduced to too small an amount; to the addition of sugar to make it equal to the amount contained in human milk; and of lime-water to change it from being an acid to an alkaline fluid; I have fallen upon several improvements to render it easier to get together the required amounts of the different constituents and thus simplify the work of the nurses; besides which, I have had a good deal of experience in the actual use of the food, and therefore opportunity to observe its clinical effects. It is only in the directions indicated that I have anything which is absolutely new to detail, but perhaps some account of them may not be without interest to the members of the Society.

In the mode of preparation of the food, I have made one change which, though it in the end arranges the constituent parts in exactly the same proportions, is an improvement in that it simplifies the preparation and offers less chance for fermentation to take place. Cream is a material which, as it is ordinarily obtained in cities, and even if people have their own cow, has been kept so long that it is very liable to become sour. I therefore now direct—and this was alluded to in an article I published some time ago *—that instead of taking cream and milk in the proportions respectively of two and one in eight, three parts of a weak cream be used, which is obtained as follows: One quart of good ordinary milk is placed in a high pitcher, or other vessel, and allowed to stand in a cool place for three hours; then one pint is slowly poured off from this, care being taken that the vessel is not agitated, the object being to obtain the upper layer of fluid, rich in fat, and leave the lower, comparatively poor portion behind. When the child is to be fed, there are taken of this weak cream three tablespoonfuls, of lime-water two tablespoonfuls, and of sugar-water three tablespoonfuls. The sugar-water is to be made in the proportion of eighteen drachms of milk-sugar to one pint of water. This makes only four ounces of food, and if the infant is old enough to require eight ounces at once, double the quantities of each of the ingredients must be mixed. This is simply warmed in a bottle, as usual, and is then ready for use. Analyses of mixtures made according to these directions have shown me that the proportion of fat is the same as when the food is prepared as recommended in my earlier works, and the plan is much better, because more economical (cream being expensive), and the food is less likely to ferment. In the article by Rotch, which has already been quoted, he suggests that it is of advantage to use the sugar in powder instead of dissolving eighteen drachms of milk-sugar in a pint, and recommends the use of three and three-eighths drachms of sugar to eight ounces of food, to be made exactly as directed above, except that the sugar-water is then substituted by an equal amount of plain water. To obtain the desired amount (three and three-eighths drachms) of sugar, he has had constructed a little measure which will hold just that quantity. Doubtless this suggestion is a good one, and in many instances it will be of advantage to follow it. He also criticises my food on account of the amount of lime-water it contains, and says that it is much more strongly alkaline than

* A paper read before the Pediatric Section of the New York Academy of Medicine upon the "Dietetic Management of the Summer Diarrhœa of Infants," *Medical News*, July 7, 1888.

human milk. This statement he supports by saying that he has had the degrees of alkalinity of the two fluids, human milk and an artificial food, made as I have directed, tested, with the result above stated. As he does not mention the method used in making the test, though it was presumably by neutralizing certain quantities of an acid of a standard strength, and as clinical experience, which I have already said I think should be given much more weight than theoretical reasoning when unsupported by practice, has given me most admirable results, much better than with any other food, I am disposed still to think the mixture a good one. The criticism of Rotch is however a just one, and quite admissible, and it will be for the future to determine which is the better proportion of lime-water, the amount I have recommended or that he suggests (one-sixteenth of the total volume).

During seven years I have had a good deal of experience in the use of the food in private practice, and in the last two in an institution where there are always quite a number of foundlings. From both methods of trial the results have been better than my most sanguine hopes had led me to expect. In private practice, if I have had intelligent people to deal with, and could gain their confidence so that they would do exactly as I directed, the result has almost uniformly been success; on the other hand, if people are foolish, and try a succession of different foods, or are impatient, so that they will not hold to the plan long enough to give it a fair trial, failure often attends one's most strenuous efforts. The greatest difficulty that I have to contend with in the effort to artificially feed any infant successfully is this natural impatience on the part of parents, which expresses itself in the desire to be constantly trying different foods in such rapid succession that no one of them is given an adequate trial. The task of the physician therefore is, and an infinitely difficult one it often proves to be, to decide in his own mind definitely what food will be most suitable for any given case, and then with all his might, until there arises some real and definite reason to think he is in error, to hold to it in despite of the opposition of parents, nurses, relations, and friends. His worst enemies will often prove to be the nurses, especially if they be old, for the knowledge necessary to make up the education requisite for nursing is just enough to make them often think they know much more than they do. How often I have been brought almost to desperation by finding that an old nurse was defeating all my best-laid plans, and in such a way that I was entirely powerless to effect anything!

The results of the use of the mixture during my terms of service in the past two years in an institution have been most curious. There can be no test of an artificial food so severe and none therefore so good as to feed infants with it from the very hour of their birth, and it has always been my desire to test my mixture, if the opportunity ever arose, in this manner. When I began its use in an institution (the Sheltering Arms of Philadelphia), I was careful to direct its administration only to very young infants, upon their first coming under our care, and to those who after a fair trial of whatever they might previously have been taking evidently did not thrive, so that a change became necessary. No radical change, therefore, was made in the manner of feeding infants already inmates of the institution. The general results attained at the end of my first term of service were most discouraging, all the infants brought in during the first few weeks of life died, and many of the older ones, and the worst was that a goodly number of them died of infantile atrophy. When I looked back and contemplated the result of my efforts,—total failure,—I was at times disposed to be in despair, and to give up the struggle which had been in many ways a very hard one, and in the course of which I had had many obstacles to contend with, some of which had been overcome while others had for the time proved insuperable. Two things, however, would return to my mind whenever I thought of the subject, and their contemplation gave me courage to renew my efforts,—they were that in private practice I had had such uniformly good results from the use of the same food, and that the class and condition of the infants was such as necessarily to render their rearing a most difficult task, for most of them were brought to us in a very bad state of nutrition, and were, in many instances, foundlings that had been already half starved or exposed. Reflection upon these considerations could but lead to one of two conclusions: either the infants were, without a single exception, so unhealthy that they had not sufficient vital force to live upon a food that did perfectly well in almost all instances in private practice, or else my directions had not been thoroughly carried out. Soon the further conclusion forced itself upon me that the latter must have had a large influence in causing my failure, for among my subordinates, who were to carry out my plans, not one—nurses, attendants, or any one else—had the slightest faith in my method, and though in some instances I was sure they conscientiously did their duty, yet it was only in a half-hearted way, for they had no faith, and looked forward only to failure; in others, I had reason to know that the food was not given as directed. When the time came to enter upon a second term of service the aspect of affairs had undergone a great change, all those who were to work subject to my direction had been long enough in the institution to have become pretty well discouraged at finding their own efforts almost entirely futile, as a very large proportion of the infants still continued to waste and die. The only notion that seemed very prevalent and to have much strength was a belief that Mellin's food was a very excellent thing. As I had already formed a favorable opinion of this food myself, I determined to turn the desire to use it (that evidently existed) in the direction of gaining my own ends. This I did by directing that the infants, all those young enough, should be fed upon my mixture with the addition of a teaspoonful of Mellin's food to each eight ounces, and by this means began my work with a satisfied and even enthusiastic set of assistants. It was soon found necessary to do something to make it easier to obtain the needed weak cream than setting it in pitchers, and this was easily accomplished by having a high tin cylindrical vessel made about six inches across and perhaps a foot or eighteen inches in height, which would hold exactly six quarts. In the side of this vessel, just half-way between top and bottom was a small hole which was stopped with a cork; this simple arrangement being used rather than a stopcock, because so much more easily kept clean. This vessel was filled with milk, and, after being allowed to stand for three hours in a cool place, the cork was removed and the upper half of the milk ran into a vessel placed to receive it, giving three quarts of cream of the desired strength. The results obtained from the use of the food during last winter were simply marvellous, one or two infants that were so wasted when the change was instituted that it seemed that they must surely die recovered, becoming well nourished and healthy, and throughout the whole season we only lost one baby of true infantile atrophy. It seems to me that it would be very absurd to suppose that the good results attained were in any material way brought about by the addition of Mellin's food, which I used merely to please my assistants, for I have as a rule had just as much success in private practice when it has not been used.

Most of these infants throve and seemed to be well until they were nine months or even a year old; but during the past summer many of them have died. The most common mode of death was for them to be seized with convulsions while in apparently good health, except that they were teething, and to die in from a few hours to a day or two. Notwithstanding these great discouragements, it really seems as if a step in advance had been made, for, so far as my own experience is concerned, I have succeeded in preventing the immediate commencement of wasting in foundlings upon their admission to an institution. The question remains an open one, whether they died during the teething process, as they did, because the diet was faulty, or if it was on account of bad regimen. For my own part, I am more than half inclined to think the latter, for in private practice and in the institution I have used exactly the same food, but how different has been the care and management of the infants, and how different the results! It is to be hoped that further study and more time will enable us to overcome the difficulty, whatever it may be, though it should be remembered that the material dealt with (foundlings already injured by exposure and neglect, and a large proportion having within them the seeds of hereditary disease) must always be the most difficult possible to manage.

There can be no doubt, I think, that of late years we have made very great strides in advancing our knowledge of the proper *rationale* of infant-feeding, and have had correspondingly increased success in coping with the practical difficulties to be overcome, as evidenced by the much larger number of infants that are successfully brought up by hand. It is unfortunate, however, that the knowledge which makes it possible to do this is still confined to a comparatively small part of the profession, the majority of physicians not interesting themselves sufficiently in the subject to take the trouble to learn the principles upon which an understanding of the method is based. It is to be hoped that the time is not far distant when it will be as fully acknowledged and as universally known that to artificially-fed infants the best method is to take cow's milk and dilute it, and use cream, sugar, and lime-water, as it is now a common dictum that the diet in typhoid fever must be liquid.

Improved modern methods of feeding, and the greater degree of success attained thereby, have made it proper to look upon the question of employing wet-nurses from a somewhat different stand-point from formerly. The results of artificial feeding used to be so bad that in all cases, if it was in any way possible, it was wrong not to obtain a wet-nurse. Now we may give much more weight to a consideration of the many risks run from the woman's being perhaps diseased or having an insufficient supply or bad quality of milk, and that they are so apt, in this country at least, to become discontented, and go away without previous notice, just at some critical period of the infant's life. The class of society from which wet-nurses are drawn is a very low one, for they are, as a general thing, either women from the lowest ranks of life, who have had illegitimate children or have been deserted by their husbands, and therefore the chance of their being diseased is very great; and, besides, they are generally of such a low order as to be difficult to manage. Upon the other hand must be set the facts, that in artificial feeding, if the food is impure or the various component parts are not present in the right proportions, the fault is ours, and the remedy is easily applied. If we have intelligent people to deal with, and have their full confidence, so that they will carry out implicitly the directions given them, infants may be hand-fed with great success, and in some instances with more success than from the employment of wet-nurses, though, of course, there is not now and probably never will be, found any artificial food which will be equal to that provided by nature when it can be had at its best.

The end to be striven for in order that more general success may be attained in the artificial feeding of infants is to diffuse more widely and to make common property of the knowledge how small a proportion of casine exists in human as compared with cow's milk, and that in addition to the dilution which is necessary to reduce the amount of this constituent we must use in proper proportions,—cream, sugar, and lime-water.

DISCUSSION.

DR. HOLT.—I have had quite a large experience in the use of the mixture suggested by Dr. Meigs, and it has seemed to me that it was a better working formula than any which I had previously used. As he has stated, there are some objections, but these can be readily overcome if the patient is intelligent and can be brought to realize the importance of the measures. The simplest way of making the sugar-water is to add eight heaping teaspoonfuls to a pint of boiling water. That makes about the strength indicated by Dr. Meigs. If the water has been boiled, we are sure that it is sterilized. Sugar of milk is liable to contain impurities; but they can be easily filtered out of a solution.

There is another side of this question which seems equally important,—that is, the quantity and the frequency of feeding. Many mistakes are made in regard to these points. For some time I have given attention to the measurement of children's stomachs, and have made a series of experiments, having the children weighed before and after nursing. It has been my experience and observation that artificially-fed children are often fed two or three times too much, and also much too frequently, especially at night. There is no doubt that indigestion and diarrhœa are due, in very many cases, quite as much to the quantity and the frequency of feeding as to the quality of the food given. Even if the food is properly prepared, trouble will follow if attention is not paid to the quantity given. Often, by no other treatment than reducing the quantity of food, we cure a prolonged dyspepsia.

DR. KEATING.—This is a subject in which I have taken considerable interest; and I have followed Dr. Meigs's investigation with care. It has been the experience of every one that infants thrive better on milk if it is diluted. The great mistake has been over-feeding.

There is another important point. The nutrition of the infants does not depend alone upon the quality of the milk taken. This milk must be digested and assimilated, and many weak and feeble children who inherit faulty digestions are not able to digest the milk. We have, therefore, in addition to the preparation of the food, to prepare the digestive organs, and see that the proper juices, on which depend the digestion and assimilation of the food, are secreted. This is a matter which should be taken into consideration in discussing this subject, and must never be forgotten.

Dr. Fruitnight.—I have but a word to say in reference especially to the method of administering artificially-prepared foods. At a recent meeting of the physicians of St. John's Guild of New York, it was the universal opinion that the ordinary nursing-bottle, with the long tube, should be prohibited, and that it was a frequent cause of gastric and intestinal derangement. It was the sense of those present that the simple nipple should alone be used.

Dr. Booker.—I have used Dr. Meigs's preparation in a number of cases of summer diarrhœa, and have gotten good results in some. There are, however, many cases of diarrhœa in which cream is not easily digested. If the fæces are examined, oil globules are found in large quantity. I therefore do not see the advantage of increasing the quantity of cream when they cannot digest that which is ordinarily present. I now use sterilized milk, diluted with water, according to the age of the child, and have obtained as good results, if not better, than with any other preparation.

Dr. Winters.—It has been remarked that the majority of physicians take more kindly to so-called infant's foods than to cow's milk. It is the experience of every physician that it is unusual to find children artificially fed with cow's milk. This is true not only in the city, but also in the country, where fresh cow's milk may be readily obtained. My experience coincides with that of Dr. Meigs in regard to the value of milk and the failures with artificial foods.

The method of obtaining cream fresh from the milk is also of importance. During the spring of 1881 I delivered some lectures on the feeding of infants, and at that time I stated to the class that, in my opinion, there was only one food for children deprived of the mother's milk, and that was cow's milk; and that it seemed to me that I had found out a way in which children could be brought up successfully on cow's milk. This was suggested to me by a visit to a creamery where butter and skimmed-milk cheese were made. I watched the process of the separation of the casein and of the cream, and this suggested to me the method of feeding children on cow's milk, and of having a small proportion of casein in the milk. I have carried this method out in private practice for the last eight years. If fresh milk is obtained, and from this cream is taken, as Dr. Meigs suggests, and if attention is paid to the quantity given and the frequency of feeding, there is no difficulty in bringing up children on cow's milk. Among the poor, in large cities, the difficulty is to obtain fresh milk. The bulk of artificial feeding is now among the tenement population. The wealthier classes seem more disposed to nurse their children than they did five years ago.

Dr. Adams.—In 1885, when I denounced all sorts of infant foods, in an article on "How shall we feed the Baby?" in the Archives of Pediatrics, it was with "fear and trembling" lest the physicians who endorsed them would attack me. There has certainly been a great reaction since that time, for no one present has endorsed a single food during this meeting. My experience has led me to the conclusion that cow's milk, properly prepared and properly administered, is the only substitute for human milk. I accept the method of preparation recommended by Dr. Meigs as the best.

In the Children's Hospital of this city, we have had very few cases, during the past summer, of simple gastro-intestinal catarrh. In two cases my success was not such as I had had in private practice, and, on investigation, I found that the resident physician was experimenting with peptonized and pancreatized milk. As soon as this was stopped, and properly prepared cow's milk substituted, the cases quickly recovered.

In a recent paper in the Archives, I call attention to a new form of food, in which the sterilizing process has been taken advantage of to advertise a "Homœopathic Sterilized Milk." I refer to two cases, and others have come to my notice, where infants have been nearly starved to death when fed upon it. This is, therefore, to be added to the long list of unreliable foods.

Dr. Caillé.—I am surprised that Dr. Meigs did not refer to the sterilizing process in the preparation of his mixture. It is just as important to prepare the milk properly and keep it properly as to give it in proper doses at proper intervals; and as some of the main difficulties in infant-feeding are overcome by sterilizing the food, the process of sterilizing by steaming should receive proper mention whenever the subject of infant-feeding is under discussion.

Dr. Jeffries.—In regard to sterilizing milk, it is important to recognize the fact that the sterilizing should be done early. Many sterilize the milk after it is partially decomposed, and the chemical products are then left in the milk. Such milk is poisonous to animals and to children.

Dr. Meigs.—In reference to measurement of the stomach after death, I have found the greatest variation in size of the stomach in infants of the same age, the capacity being sometimes as little as five drachmas, and again as much as eight ounces, in young babies. The size of the stomach depends much upon the mode of death; and therefore I do not think accurate or valuable results can be obtained in this way. In regard to ascertaining the amount of food taken, by weighing infants before and after nursing, it would seem that no very reliable results have ever yet been obtained by this procedure. The method was introduced by Guillot, and further elaborated by Parrot (Clinique de Nouveaux Nés), but he concludes that the amounts taken by young infants are so small (six or eight ounces in twenty-four hours), that his results must be looked upon as erroneous. Dr. J. Forsyth Meigs published an essay in which he gives the amounts drawn artificially from three different healthy women in twenty-four hours, and the average was a quart or a little more. Even an observation of this sort would have more value than many experiments of weighing infants before and after nursing, for the results, so far as they go, are absolute.

The fact that oil is found in the pus of artificially-fed infants has never seemed to me to be a valid argument against the use of cream, for free oil is always present in the stools of nursed infants, and it is not for us to judge why nature provided an excess of oil. When by some method of artificial feeding we obtain better results than are to be had from infants being nursed, then we may criticise the presence of free oil in the fæces.

The subject of the sterilization of milk I did not touch upon, because there was not time to do it justice without occupying more time than could be given. It does not seem to me to be necessary in all cases; and among the very lowest classes, where the necessity for it is greatest, it is almost impossible to have it adequately carried out, owing to the ignorance and helplessness of the people. In some instances, and where it is thoroughly done, its value is, without doubt, very great.

RECENT IMPROVEMENTS IN INFANT-FEEDING.*

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No subject relating to the care of infants, in the first year of life, is more important than the selection and preparation of their food when they are deprived of breast-milk, and none has received more attention. The use of improper or badly-prepared food is a common cause of infantile sickness and death. Infants deprived of their mother's milk, or its substitute, the milk of the wet-nurse during the period when nourishment at the breast is the proper mode of alimentation, have until recently, if we may speak from our experience in New York City, nearly all perished soon after birth, and from causes which were plainly referable to the mode of feeding. This remark is not an exaggeration. My observations fully justify the statement. Several years ago, before the New York Foundling Asylum was organized, the foundlings of New York were assigned to the care of the pauper women in the Almshouse on Blackwell's Island. Their diet consisted mainly of cow's milk, which arrived every morning in cans from the country, and was prepared and administered according to the judgment of these women, or of the matron. It was more or less diluted with water, and sometimes some farinaceous substance was added. The steamboat every morning brought foundlings to the island, and every afternoon removed an equal number for burial in Potter's Field. To me was assigned the unpleasant duty of visiting and prescribing for these foundlings, and a single infant was pointed out to me which had not died in the usual time.

When the New York Foundling Asylum was incorporated, in 1869, the foundlings received the care and personal attention of a large, intelligent, and self-sacrificing sisterhood, and a liberal outlay of money provided for the wants of the found-

* Read by title.

lings. But under the intelligent management of this institution the discovery was soon made that foundlings without the breast-milk gradually wasted, had indigestion, vomiting, and diarrhœa, and finally a gastro-enteritis, ending in death. A large maternity service was established in the asylum, which provided wet-nurses, so that a considerable proportion of the foundlings receive breast-milk, and their lives are saved; but the foundlings are numerically in excess of the wet-nurses, and the result of the bottle-feeding of those who are not wet-nursed has been similar to that in olden times in the Almshouse.

The experience as regards the disastrous results of bottle-feeding has been the same in the New York Infant Asylum as in the Almshouse and Foundling Asylum. This institution was at first under the management of Mrs. Richmond, a woman of great executive ability and intelligence. She obtained the charter for the asylum in 1865, organized and opened it, at an apparently favorable site on the banks of the Hudson, but within the city limits. In this institution also the fatal mistake was at first made of bottle-feeding the infants, a mistake with which I was more and more impressed each day, as I was the attending physician. About twenty-five infants, mostly under the age of two months, were admitted at the opening of the building, and were fed from the bottle, as were also those who were subsequently admitted; but, as in the Almshouse, the deaths from innutrition, diarrhœa, and marasmus were equal in number to the admissions, so that, although cribs had been provided for one hundred and fifty infants, it was seldom that more than twenty-five or thirty were occupied. The disappointment of the devoted and philanthropic woman at the head of the asylum probably shortened her life. After her death the asylum was reorganized, a large maternity ward added to it, which furnished wet-nurses, and since this change the death-rate has been greatly reduced, and the Infant Asylum is now regarded as one of the best-conducted, and most successful of the charitable institutions in New York.

Facts might also be presented showing the unfavorable results of hand-feeding in private or family practice. Wet-nurses are largely employed in New York even in families in which the mothers are fully competent to suckle their own infants, and the mortality of the infants of the wet-nurses, thus abandoned by their mothers and bottle-fed, is very great. According to my observations, a large majority of them die, and in the same manner as in the institutions, the mortality being soonest and most certain in the summer months, when gastro-intestinal diseases are most prevalent. But it is not necessary to cite instances showing the disastrous effects to young infants of the substitution of artificially-prepared food for breast-milk, for, however it may be with the laity, physicians are fully aware of the facts as I have stated them.

But in the large cities, and especially among the poor of the cities, there are many instances, in which maternal lactation is impossible, and wet-nurses cannot be obtained on account of the expense, or for other reasons; and how to feed these infants, deprived of nourishment at the breast, is one of the most important problems which the physician is called upon to solve. In my opinion, in order to obtain a clear and accurate understanding of the subject which we are now considering, it is necessary to accept the following propositions:

1. Mothers who are fully capable should wet-nurse their own infants until the age of ten or twelve months. The common practice in wealthy families of employing wet-nurses, from the belief that lactation impairs the health and reduces the strength, or in order that the mothers can have more time for social purposes, should be discouraged. There are other and strong reasons why mothers who are in good health should suckle their own infants, but a sufficient reason is that gross injustice is done to the infants of the wet-nurses, since, as we have seen, a large proportion of them die when abandoned by their mothers. But a mother with grave organic disease, or with permanent ill-health, which reduces the quantity and impairs the quality of her milk, should not be allowed to suckle her infant. She should consent to the employment of a wet-nurse.

2. The employment of a wet-nurse is preferable to hand-feeding for an infant under the age of six or eight months, provided that she have the proper qualifications. But hand-feeding, with its risks, is preferable to the employment of a

wet-nurse who has not the proper mental and physical qualifications, such as temperance, equanimity, a sense of duty, good health, and sufficient milk. I could mention instances of the most disastrous results from the employment of bad wet-nurses. A recent western medical journal published the experience of a family, who allowed their wet-nurse to visit her friends one evening. She spent the night in debauchery, and returned haggard and fatigued on the following day. The baby took her breast, but was immediately seized with vomiting and purging, which ended fatally in a few hours. I could mention instances, which I have observed in New York, in which severe sickness, and sometimes death, resulted from the employment of wet-nurses mentally or physically unfit for the task which they had undertaken, so that I repeat it is better to bottle-feed the baby than intrust it to a wet-nurse who is lacking in any of the important qualifications.

3. Animal milk should be the basis of all artificially-prepared foods for infants. This fact is recognized in the preparation of the many infantile foods which the shops contain, since milk largely enters into their composition, or it is added in the nursery.

4. Animal milk—by which I mean cow's milk—is digested more slowly and with more difficulty than human milk; and its indigestibility is largely due to its casein, which exists in larger proportion than in human milk, and is likely to coagulate in the stomach in large curds, on which the gastric juice acts slowly. In order to produce coagulation in small masses or flakes, such as occur in human milk, and thereby render the digestion of cow's milk more easy, the following methods of treating the milk have been proposed: 1st, steaming the milk, or subjecting it in a steamer to a heat of 180° to 190° F. not less than two hours. The prolonged action of heat at this temperature appears to render it less liable to form large curds in the stomach; 2d, peptonizing the milk by the process recommended by Fairchild Brothers; and, 3d, adding to the milk, at each feeding, some farinaceous substance, as barley flour, which mechanically separates the particles of casein, and thus tends to prevent the formation of large caseous masses in the stomach. All three of these methods, de-

signed to promote the coagulation of casein in small masses or flakes, and thus facilitate its digestion, are useful in practice.

5. The fact is stated in the text-books, and in monographs relating to infant-feeding, that infants under the age of three months are able to digest only a very small amount of starch, since the glands, which secrete saliva, which is the chief agent in digesting starch, exists in an almost rudimentary form until after the third month. But starch converted into glucose by the action of the diastase of malt, or into dextrine by the prolonged action of heat, can be digested by the youngest infants.

6. In the feeding of infants, food which is not entirely predigested, and which therefore stimulates the functional activity of the organs which furnish the digestive ferments, is preferable, as a rule, to food which is entirely predigested, and which therefore requires only absorption, provided that the digestive organs are not over-taxed, and the digestion is easy and complete. This statement is based on the fact that the healthy development of the infant requires the normal functional activity of all its organs, of those of the digestive system as well as of the other systems; but for infants in a very prostrated state food of the proper kind, which is fully digested, may for a time be preferable.

The increased attention given to infant-feeding in this country in recent years, and the contributions to the literature of this subject by such well-known specialists in children's diseases as Rotch, Meigs, and Jacobi, have certainly had its effect in improving the diet of infants, and diminishing the frequency and severity of diseases of the digestive system in the critical period of infancy. The occasional irrigation of the stomach of the infant suffering from indigestion and gastric catarrh, by which noxious products are removed and a healthier digestion produced, brought to the notice of the profession in America by Dr. Seibert, and successfully practised by him, has apparently been very useful in some instances. The exhaustive study of the microbes of the gastro-intestinal surface by Booker, has made known to the profession a knowledge of the agents, by which unhealthy fermentative changes and gastro-intestinal catarrh are produced, so that the remedies can be more intelligently employed. The sterilization of milk, recommended by Soxlet, whose apparatus for this purpose was exhibited by Dr. A. Caillé to the Pediatric Section of the New York Academy of Medicine, by which the microbes which produce early fermentative changes in the milk are destroyed, is now generally practised in New York, with much apparent benefit.

With the knowledge thus obtained by the experience of competent observers, we are now able to announce a mode of feeding infants deprived of breast milk which gives far better results than were obtained by the methods formerly employed. The following mode of preparing the food and of feeding infants, which I find useful, and in most instances satisfactory, may afford some assistance to those who have not given special attention to infant-feeding.

Cow's milk of the best possible quality should be obtained from a company that promise to inspect the dairies that furnish the milk several times during the year, and exclude such cows as are ailing. They should provide good pasturage, free from noxious weeds, and with abundant pure drinking-water; should reduce the temperature of the milk to 60° F. immediately after the milking, in open vessels surrounded by ice or running water, and make no subsequent addition to it. It should be delivered in air-tight bottles, so that it receives none of the air from the streets, which, in the cities, is loaded with organisms, pathogenic and non-pathogenic, especially in dry and windy weather. Milk, as I have stated above, should be the chief ingredient in the food of infants. As soon as received by the family, it should be placed in a steamer, with the cover of the bottle loosened, and should be maintained two hours at a temperature of 180° to 190° F. This destroys any microbes which may have fallen into the milk from the udder of the cow or from other sources, and arrests any chemical change, which begins early when microbes are present, especially in warm weather. After the steaming, it should be surrounded with ice in the refrigerator. This mode of steaming is essentially Soxlet's and Caillé's method.

The second and an important ingredient in the food of infants is the flour of one of the cereals. It should, in my opinion, be flour that has been subjected in a dry state for days to the heat of boiling water, which converts a considerable portion of its starch into dextrine; and if a part of the starch is not dextrinized, it appears to be so changed that it is easily digested, not overtaxing the digestive function of infants under the age of three months. In New York I now constantly prescribe barley flour which, in a double-boiler, has been subjected to the heat of boiling water for seven days. For convenience of prescribing, it has been placed in a drug-store (McIntyre's, Fifty-sixth Street, Sixth Avenue). I have also induced a family to prepare wheat flour in a similar manner; but they have been unwilling to place it in a drug-store, as they have obtained an abundant sale of it at their house.

How shall the flour thus prepared, and the milk which has been sterilized by heat, be used in the nursery. The following are the directions, which I have repeatedly given to nurses, and in most instances I have not been obliged to change them: Add a heaped tablespoonful (nearly two even tablespoonfuls) of the flour to eighteen of cold water, which has been boiled. The gruel may be brought to the simmering point, to facilitate the admixture. For infants over the age of six months, in ordinary health, six tablespoonfuls of the sterilized milk and six of the gruel may be mixed for one feeding. Salt should be added until it can be tasted.

For infants between the ages of three and six months, and for those older than six months, who have symptoms of indigestion or gastro-intestinal catarrh, it has seemed to me advantageous to peptonize the milk; and I have thus far employed for this purpose the peptogenic powder prepared by Fairchild Brothers. Five tablespoonfuls of milk, two of the barley flour, two of water, and the peptogenic powder as much as fills the small measure which accompanies the powder should be mixed and heated six minutes with constant stirring, but not at a temperature too hot to be sipped (Fairchild). The food thus prepared should be fed to the infant at intervals of three hours, or, if it be hearty and fretful, at intervals of two and a half hours.

It is very important to determine how to feed infants who are under the age of three months, and are unfortunately deprived of the breast-milk. At this age the stomach is small, not holding more than two or three ounces without a distention which causes fretfulness, and the infant requires feeding every two or two and a half hours. My method of feeding infants of this age may be best shown by the following case which I have at present under observation : An infant of three weeks, previously fed with canned condensed milk, was in a critical state from a severe diarrhœa, the stools being not only frequent and watery, but only partially digested, and so irritating that a severe erythema of the nates had resulted. The infant was constantly fretful when awake and its sleep was insufficient. Two and a half tablespoonfuls of sterilized milk, one of water that had been boiled, one of the barley gruel, and the measure half-full of peptogenic powder, mixed and heated six minutes, with constant stirring, were given to the child every two hours. Each feeding was preceded by a dose of subnitrate of bismuth and a small amount of pepsin, the use of which, under such circumstances, we will presently consider. The infant with this feeding immediately improved. The fretfulness ceased, the stools became less frequent and of normal appearance, and the family, entirely satisfied with the result, are not inclined to follow my advice to obtain a wet-nurse.

Often, in New York, physicians are summoned to infants who have severe diarrhœa, probably with vomiting, the result of improper feeding. Such attacks are common in the summer months, and the disease is often designated cholera infantum. Usually, I think, in these cases it is best to withhold all milk for perhaps two or three days, and administer only cold barley water, with no addition except salt and perhaps the white of the egg. In severe cases I have administered only this food during several successive days.

The medication of young infants is to me unpleasant, and I do not prescribe medicines for them if I think that a healthy and normal state of their systems can be procured by hygienic measures; but so many infants die from imperfect digestion of their food, and consequent malnutrition, that I do not hesitate to recommend for use at each feeding, if there be symptoms of indigestion, some form of pepsin, which will aid the digestive process. The following are formulæ which I have employed with apparently good results during the last two years.

℞ Pepsini puri, in lamellis, ʒi;
Lactopeptine, ℥ss. Misce.

Sig.—Give half as much as will go on a ten-cent piece to as much as will cover a nickel five-cent piece before such feeding.

℞ Pepsini puri, in lamellis, ʒi;
Vini pepsini, N. F., ℥ss;
Aquæ destillat., ℥iiiss. Misce.

Sig.—Give twenty to twenty-five drops to an infant of four to six weeks before each feeding, and one teaspoonful to an infant of six months.

If vomiting or diarrhœa be present, subnitrate of bismuth should, I think, always be given in large doses with the pepsin. The following are formulæ which I employ.

℞ Bismuth subnitrat., ℥ss;
Pepsini puri, in lamellis, ʒi;
Vini pepsini, N. F., ℥ss;
Aquæ destillat., ℥iiiss. Misce.

Sig.—Give one teaspoonful before each feeding to an infant above the age of six months, half a teaspoonful between the ages of two and six months, and twenty-five drops to infants under the age of two months.

℞ Bismuth subnitrat., ℥ss;
Pepsini puri, in lamellis, ʒi. Misce.

Sig.—Give, before each feeding, as much as goes on a ten-cent piece to an infant of three months; to one of six months, as much as goes on a five-cent nickel piece.

The good results, in my practice, of the mode of feeding which has been described above was apparently mainly due to the use of sterilized and peptonized milk and barley flour, subjected to the prolonged action of heat (seven days) and to use of pepsin with each feeding, if symptoms of indigestion occurred, and subnitrate of bismuth in large and frequent doses, if symptoms of gastro-intestinal catarrh appeared. Other writers on the diet of infants have published formulæ for the preparation of foods which have undoubtedly been useful and some of which I can recommend from personal observations, but the mode of feeding which I have described is perhaps the best with which I am acquainted for general use. Still, I hope to learn from the Pediatric Society some better mode of infant-feeding, especially as I see by the programme that one who has had ample experience, and is widely and favorably known for his contributions to the dietetics of infancy and childhood, will also discuss this subject.

TREATMENT OF SCARLET FEVER AND ITS COMPLICATIONS.

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BECAUSE the subject of this paper is a broad one, and its discussion can be extended to an undefined limit, I shall invite attention more particularly to certain points, such as the treatment of the fever, the angina, and the specific complicating nephritis, otitis, and cervical cellulo-adenitis. Others will be cursorily touched upon. It is not anticipated that anything new or startling will be offered you in this article. What I have to say is based upon my clinical observations, made upon nearly one thousand cases of the disease occurring in my own practice during the last fourteen and a half years. These cases naturally have ranged in severity from those of scarcely a week's duration to those which have dragged their length into weary months. The collation and comparison of the clinical experiences of many practitioners ought to be both profitable and instructive. This last-expressed idea is therefore the *motif* of the present essay.

Fever of a higher or lower grade, and pharyngeal irritation more or less severe, are the pathological factors which will be met with in every case of scarlet fever. In every case of the disease, therefore, measures must be adopted to combat these conditions. I will discuss the treatment of the fever first.

It has been quite firmly established that the human organism can be subjected to a high degree of temperature and not succumb. Though this be true, it does not follow that a *laisser faire* policy must be pursued as regards the fever; for in my opinion, if the fever can be reduced by art, the patient is made correspondingly more comfortable, and whatever tends to increase the comfort of the patient assists in directing the attack of illness, as a whole, to a favorable termination. Before the introduction of the recently-discovered antipyretics, it had been my custom to treat the fever with aconite. The preparation which I employed was the ordinary tincture of the root of the plant of the United States Pharmacopœia. I administered it in doses of one-half drop to one drop, according to the age of the patient, every hour in the beginning of the attack. When the fever had been reduced in consequence of its absorption, I prolonged the interval to every two or three hours, according to the register of the thermometer. Aconite is a remedy "which," as Dr. Charles S. Wood once aptly said in a discussion before the Northwestern Medical and Surgical Society of New York City on the use of this remedy in the treatment of pneumonia, "should go hand in hand with the thermometer." When the child is less than three years old I use the smaller dose, which is increased proportionally with older ones. When the temperature is very high, as 105° or 106°, I have employed with benefit the mode of administration of the remedy so highly recommended by Sidney Ringer, of London,—that is, one drop of the medicine is given every fifteen minutes for one hour, thereafter hourly two or three times, after which the interval is prolonged, and its further administration is to be decided by the thermometric record. Concerning the *modus operandi* of the drug I shall not speak, merely recalling the fact that it is classified as a cardiac sedative. Because of this depressing effect upon the heart, its use has been condemned by some able and celebrated physicians. I, however, have never had any bad results from its use. In the milder cases of the disease, and in cases occurring in robust patients, the system was enabled to tolerate the medication. In cases of an adynamic type, stimulating treatment was also very soon inaugurated, which *pari passu* helped to mitigate, if not to prevent, any deleterious effect of the remedy on the heart's action.

The reduction of the temperature was always quite speedy. Without entering upon a detailed history, I will quote from my case-book the daily temperatures of several cases.

	First Day.	Second Day.	Third Day.	Fourth Day.	Fifth Day.	Sixth Day.
CASE I..........	103°	101½°	101°	100°	98¾°	98½°
CASE II..........	102°	101½°	100°	98¾°	98½°	98½°
CASE III..........	103°	101°	100¼°	100°	99½°	98½°
CASE IV..........	101½°	100½°	100°	100°	100°	99½°

Many more could be cited to show the gradual daily decline of the fever under the use of the aconite in the doses mentioned, but I must forbear, lest the tedium of their recital should become wearisome.

When the phenic series of antipyretics were introduced, I abandoned the use of aconite, and employed the former in the treatment of scarlet fever. My experience both with dimethyloxyquinizine (antipyrin) and acetanilide were not so favorable as with aconite. True, the fever was diminished, but my cases did not appear to do so well generally. It seemed to me that the reduction of the fever was accomplished at the expense of the vitality and general well-being of the patient. My patients seemed to suffer more discomfort and prostration, while at the same time the respiratory centres seemed to be unfavorably affected, as evidenced by palpable signs of anxious dyspnœa. Cardiac syncope was also threatened in a number of cases. The doses were not large, averaging from two and a half to five grains. I am not prejudiced against these remedies, for it is my impression that I was the first physician in this country to use antipyrin for fever, and in the first public report here in America on its action, which was made by me on October 15, 1884, before the Northwestern Medical and Surgical Society of New York City, I spoke very enthusiastically about it, though it was derided by the late Professor Austin Flint at that very meeting.* But for the reasons alluded to I soon forsook the treatment with these newer antipyretics, and resumed that with aconite. My later experience with this remedy only corroborated my former observations, and strengthened me in my belief that aconite was the best febrifuge to be employed in the treatment of scarlet fever.

With the hydropathic treatment of scarlet fever I have had no experience, since none of my cases have exhibited extreme hyperpyrexia, and the medicinal agents have always been able to reduce the temperature sufficiently in other cases. In the average case of the disease, however, I would hesitate

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* *New York Medical Record*, vol. xxviii. p. 364, and vol. xxix. p. 648.

very much before applying this method of treatment, because I think that other remedies are preferable. Only when the case had become desperate, and death from hyperpyrexia stared the patient in the face, could I be induced to resort to it.

During the recent epidemic of scarlet fever last winter and spring in New York City, of sixty-three cases of the disease treated by me with aconite, only three died, all of which were caused by severe cerebral complications, terminating fatally within the first three or four days of the attack.

When moderate hyperæmia of the throat exists, very little treatment is necessary, yet it is neither safe nor judicious ever to ignore even a mild angina. Small doses of chlorate of potash, from one-half grain to three grains, proportioned to the years of the child, either dissolved in water or placed dry on the tongue, will suffice. If the anginose condition be more severe, the addition of a few drops of the tincture of chloride of iron to the first-named medicine will be beneficial. If the pharyngeal inflammation be of a severer grade still, larger doses of the martial tincture should be given, even to the extent of twenty drops per dose, in combination with the chlorate of potash.

The chlorate of potash must, however, always be used with circumspection in children, for they are much more susceptible to its toxic action than adults, lest, if too large doses be permitted, serious nephritic lesions may be produced. In my opinion a child should never receive more than three grains at a dose.

If follicular deposits appear in the crypts of the tonsils, I ordinarily prescribe the hyposulphite of soda, in doses varying from two to five grains, dissolved in a teaspoonful of some aromatic water. When extensive exudations of a diphtheritic character are present, I have been induced to use, because of the good results obtained with the remedy in the treatment of diphtheria and diphtheritic croup, the bichloride of mercury; and in the treatment of scarlatinal exudative angina, I must confess that equally satisfactory results have been obtained.

When these remedies seem tardy in their action in the cases in which the throat is severely involved, I have supplemented their use with local treatment, applied by means of the spray atomizer. For its solvent action I use trypsin in the presence of an alkaline solution, and for its disinfectant and deodorant effect, Lugol's solution in the atomizer, alternately. In all cases accompanied by fetor of the breath I use either the Lugol solution or a solution of carbolic acid as a spray for its correction, whether the case be mild or grave. The treatment of the exterior of the throat will be considered in another connection later in this paper.

In the course of any case, simple as well as severe, of scarlet fever, one must not be astonished to be suddenly confronted with any variety of complication, for the specific cause of the disease is of such virulence that the point of weakest resistance in the patient's organism will most likely be called upon to withstand its assaults. The most usual complications are acute nephritis with dropsical effusions and albuminuria, acute otitis media, and cervical adeno-cellulitis. I have named them in the order of frequency in which they have fallen under my observation.

In the treatment of the renal complication, which has occurred in about six per cent. of my cases, I insist upon the observance of three cardinal principles,—namely, rest in bed, warmth of the surface of the body, and an unrestricted milk diet.

When the urinary excretion is diminished and œdema coexist, I administer a diuretic, preferably the acetate of potash, in the usual doses, combined with the tincture of digitalis. At the same time free catharsis is procured by the administration, at frequent intervals, of small doses of the solution of citrate of magnesia in younger children, and the compound jalap powder in combination with an additional quantity of calomel for older ones. When hæmaturia is present, which I have seen quite frequently, I have sometimes given, with benefit, gallic acid, in three-grain doses, repeated every three hours. At other times five drops of the colorless hydrastis in a teaspoonful of water every three hours has been efficacious to arrest the bleeding. I also order a daily counter-irritation of the region of the kidneys by means of sinapisms. When there is great general anasarca and abdominal ascites, threatening interference with respiration and circulation, in addition to the free purgative, hot vapor-baths are prescribed. These hot baths are applied in the following manner. The patient, stark naked, is laid upon a blanket, and immediately one or two bricks, which have been in the mean time thoroughly heated by immersion in pails of hot water, and then enveloped in flannel cloths, are placed both at either shoulder and at the feet, care being taken that they are not put too near the body, lest the patient be scorched. Another blanket is then thrown over the patient and the bricks. The upper corners of the superimposed blanket are brought over and tucked under the opposite shoulders, while the other end of that blanket, with the lower end of the underlying one, are lapped together under the heels of the patient, and the head alone is left to protrude from this improvised sack. The patient is retained in this hot pack for at least twenty minutes. It is resorted to once or twice daily, according to the urgency of the symptoms. Profuse diaphoresis directly occurs when the patient is submitted to this treatment, always resulting in a marvellous amelioration of the alarming and distressing symptoms accompanying dropsical effusions. The patients and their friends are apt to complain loudly of this heroic treatment, but I can recollect several instances where the child's life was saved from imminent death by it. This hot bath will often accomplish the end sought when all other measures have failed, and this knowledge is the justification for its employment, in spite of such protestations.

As an able adjunct to this diaphoretic treatment, pilocarpine muriate hypodermically and the fluid extract of jaborandi *per orem* have been employed by me.

The occurrence of symptoms expressive of uræmic intoxication demands the remedies appropriate thereto. The convulsions I treat preferably by means of rectal injections of chloral hydrate, of the strength of five grains to a drachm of water. This dose is thrown into the rectum every fifteen minutes until the convulsions shall have ceased. Coma I have always combated by speedy and active purgation, by the administration of a fraction of a drop of croton oil suspended in a blander oil, which is placed far back on the tongue. At the same time the patient is subjected to the vapor-bath previously described.

Finally, when the more acute symptoms of the renal complication have abated, I without delay put the patient upon some chalybeate preparation, which is to be continued for a considerable period of time. I always begin with the muriated tincture of iron, and later follow it with the compound citric acid preparations of iron with ammonia, quinine, or strychnia, according to the special indications of each individual case. Occasionally the patient will not tolerate the tincture of the chloride; then I substitute for it the acetic tincture of iron of the German Pharmacopœia, with better results. With this line of treatment I have lost but three cases of scarlatinal nephritis since I have been actively engaged in practice, which is a mortality of extremely low per cent. for that complication.

Though it be the opinion of many that a scarlatinal otitis will take care of itself, yet the numerous individuals with impaired hearing, traced back to an attack of scarlet fever, whom we meet, demonstrate how fallacious this view is. Even slight attacks of ear-disease occurring in the course of scarlet fever must not be disregarded. The aural complications may be varied in nature and location. The most usual one, however, is an otitis media, either catarrhal or purulent, and occasionally diphtheritic. When tenderness and pain are complained of in the region of the ear, and symptoms of inflammation are developing, I make use of warm fomentations to the part, in the form of flannel cloths wrung out of either plain hot water or out of a decoction of either poppy-heads, chamomile, or hops. In the auditory canal a solution of warm salt-water is instilled, to which I have sometimes added a few drops of some opiate, or of a twenty-per-cent. solution of muriate of cocaine, the amount to be graduated to the acuteness of the pain. When the mastoid process of the temporal bone becomes involved, and is hot, tender, and swollen, I apply a leech to the part, which soon relieves the tension and congestion. If the pain should be referred to the tragus, the leech should be used there also. By filling the meatus with cotton, the leech cannot slip into the ear. If the patient have hæmophilic tendencies, the bleeding from the leech-bite may give rise to difficulty in its arrest. I met with such an example a few months ago, in which for nearly two hours I was unable to stop the flow of blood.

If by inspection in severe cases we can satisfy ourselves that the tympanum is projecting and is highly congested, presenting the appearance as though pus was accumulating behind it, the membrane should be incised, to liberate the imprisoned matter. This procedure will be followed by a great alleviation of the patient's symptoms. Even if no pus be present, but an intense hyperæmia only, *paracentesis tympani* should also be done, because by the release of the blood the patient's symptoms will greatly improve. When otorrhœa is profuse, whether of offensive odor or not, it is necessary to keep the auditory canal clean and free. In the simpler cases lukewarm saline solutions are indicated, and when fetor is present the addition of a disinfectant and deodorizer, such as boric acid, carbolic acid, Labarraque's solution, or permanganate of potash, in sufficient strength, should be added. I have used all of them at various times. This washing-out of the canal I advise to be done several times daily. After its completion the ear is gently wiped out with absorbent cotton, plain or medicated. Insufflation of the dry powders I do not use, because I think they would interfere with the free drainage and outflow of the discharges, and thus, perhaps, favor a possible extension of the inflammation to deeper structures, and even to the meninges.

After all acute symptoms have passed by I make use of astringent solutions to arrest the residual otorrhœa, usually a solution of the nitrate of silver of five or ten grains to the ounce of water. Of this solution a drachm is added to a pint of lukewarm water, the whole of which quantity is used at one sitting, and the operation is repeated three times daily. After the syringing has been done and the canal wiped dry, I instil in the ear three to five drops of sweet almond-oil, which has been gently warmed in the following way. A teaspoon is dipped in warm water; the drops of oil are poured into the spoon thus warmed, and from it let fall into the ear. I forbid the introduction of cotton pledgets into the ear, but at the same time caution strongly against the exposure of the affected side to direct currents of cold air. The course of treatment thus conducted has always given me the best results and the greatest satisfaction in the management of aural complications.

In the treatment of disease one can do too much oftener than too little. This reflection applies with great force to the treatment of cervical cellulo-adenitis. When the laity observe the swelling and the œdema on the exterior of the neck, the temptation is to do a great deal and a great variety of things to relieve it. But what is the result? By their rude and energetic, though well-meant, manipulations, the inflamed structures are bruised and further irritated, the inflammatory action is increased, and the very result follows, in consequence of their active maltreatment, which they had hoped thereby to prevent, or at least to dissipate. When there is simple enlargement of the glands of the neck, with but moderate infiltration into the surrounding cellular tissue, I tell my patients to let it be, to do nothing, for nature will probably be able to cause absorption of the diseased products by the time that the attack of illness shall have run its course. Usually my prediction is verified. When the inflammation is of a severer type, I prescribe an ointment composed of slightly carbolized lanoline or vaseline, which is to be gently stroked with the finger-tips, but *not rubbed*, over the swelled tissues. The ointment should be heated a little. I emphasize the injunction that it must not be rubbed, lest by such pressure irritation should be produced, which should be avoided. If, however, appearances indicate that absorption will not take place, and suppuration threatens, then I order hot flax-seed and slippery-elm poultices to encourage it. As soon as fluctuation is palpable a free incision should be made and the pus thoroughly evacuated. The resulting wound and cavity are then irrigated with a phenated solution of the strength of one to a thousand, after which the poultices are continued for a short period. When it is evident that suppuration has terminated, basilicon ointment, impregnated with a few grains of iodoform, is applied to the wound until it shall have healed. The disinfectant irrigations are also repeated at intervals until the final closure of the incision. It is interesting in this connection to refer to the case of a little girl, five years old, who came under my care with an attack of scarlet fever during April last. She suffered with a bilateral cervical adenitis. On the right side the œdema extended up over the angle and ramus of the jaw, over the cheek and molar bone to the upper eyelid, causing the eye to close. Much to my surprise, suppuration did not occur, but with the gentle treatment outlined above the exudation was by degrees entirely though slowly absorbed. On the other hand, on the opposite side, which was not so highly inflamed, the tissues took on suppurative action, requiring incision for its cure. Though this patient subsequently also developed nephritic and rheumatic complications, she is to-day entirely well, having successfully recovered from the entire train of dangerous lesions. Though it may be a digression, I cannot forbear at this juncture to speak of the most formidable case of cervical adeno-cellulitis which has ever come under my observation. The patient was seen by Dr. J. Lewis Smith and myself in consultation. He was between three and four years old, and had passed through several weeks of an attack of scarlet fever, during which time he had been treated by another physician. We found that he had had an extensive cervical cellulitis on the right side, which had been accompanied by such profuse suppuration and deep ulceration and sloughing, that a cavity large enough to hold an egg had been excavated. At the bottom of the cavity the pulsating carotid artery lay exposed to our gaze, and its coats also were already quite deeply involved in the gangrenous process. We knew of nothing to hinder the fatal issue; ligation would have been a delusion and a snare. Early on the following day the vessel opened, and in a moment death claimed his own. I do not know whether a parallel case is on record, and its rarity has induced me to relate it at some length.

As already intimated, any form of complication may be expected in scarlet fever; among the less rare is acute articular rheumatism, for it is met with quite often. Its treatment does not vary at all from that suitable in cases of the regular idiopathic form of the disease. The salicylates have given the best results in my hands, especially when alternated with alkalies. The tendency of the rheumatism to involve the cardiac muscle and its sac in its embrace is not increased, because it assumes the *rôle* of a complication of scarlet fever. Certainly, one must be on the alert to forestall as far as possible any such trend of the rheumatic poison by watching the heart, and, on the slightest suspicion that such a contingency is to take place, treatment proper to oppose it must be at once inaugurated.

As regards the chorea, which not infrequently follows this combination of scarlet fever, rheumatism, and heart difficulty, I would state that I have followed up the treatment just alluded to with the administration of arsenic and iron for the choreic condition, and of the bromides, sometimes reinforced with chloral hydrate, to control the excessive nervous excitation.

The most formidable and most fatal complication of scarlet fever which we are called upon to face, is, in my opinion, acute cerebral meningitis, or encephalitis. The symptoms of this complication are in the majority of cases developed early in the course of the disease, and always with great intensity. The prognosis is always much more grave and unfavorable than when the cerebral affection is primary. Whether the aggressive character of the complication is due to a profound saturation of the patient's system with the specific disease, entity of scarlet fever, or to this particular localization of inflammatory action in the course of the fever, I am not prepared to say. True, hyperpyrexia is commonly present in these cases, but I do not think the usually severe course and fatal result are to be attributed to this factor. Treatment of this complication is very unsatisfactory, and I regret to say almost always without avail. Iced applications to the head, the bromides, chloral, and opium in guarded doses, to control the congestion and restlessness, in conjunction with the routine treatment of the fever, constitute the measures which I have employed.

Several cases of acute pleurisy with effusion have also come under my notice as a complication of scarlet fever, independent of serous effusions attending renal disease. They terminated favorably; the effused liquid having been reabsorbed in consequence of a tonic treatment, aided by the exhibition of diuretics, mild cathartics, and counter-irritation to the chest.

I have had very few complications of the eye, indeed, and none at all of a serious character. In these mild cases the treatment was not modified in any way, but carried out as though the eye affection was a primary disease.

The vomiting, which is usually the initial symptom of scarlet fever, does not call for any special treatment, for it will cease spontaneously as soon as the stomach shall have been emptied of its contents. In a few cases anorexia persisted, but it was finally controlled with ice-pills, bismuth, and lacto-peptine, and carbonated drinks.

Diarrhœa is more apt to complicate the disease than constipation. In a number of cases I have witnessed an almost intractable dysentery, which required very energetic treatment before it was checked. I can recollect one case last winter in which the dysenteric discharges continued for nearly three weeks. In simple diarrhœa the milder astringents and corrigents, as chalk mixture, bismuth, acetate of lead, with paregoric, have always been efficacious. In the graver forms of dysentery, I have obtained the best results from the administration of the elixir of coto bark, in doses ranging from ten or twelve drops to half a drachm in a teaspoonful of water, repeated hourly. When pain and tenesmus are prominent symptoms, I add to the coto from one-half to two drops of Squibb's liquor opii compositus, which is discontinued as soon as those symptoms have disappeared. The opium is given every two or three hours as the urgency of the symptoms indicate. If the patient betray any symptom of narcosis, or undue susceptibility to the action of opium, careful watching is necessary, and it must be abandoned before its dangerous effects should ensue.

For the constipation any of the milder cathartics will do, but what I have used with satisfaction are the suppositories of glycerin, which have been lately brought into use.

Whatever other complications, and to which I have not alluded, may occur, they must be treated in accordance with those principles which their symptoms and location may determine; for, as this paper is founded on my own experiences in the treatment of this disease, I have treated chiefly of those complications which actually fell under my care.

It yet remains to consider certain general principles of treatment applicable to the management of the disease. Isolation of the infected individual is the only prophylactic treatment of which I know. This quarantine must be an honest one, and must be maintained until the period of desquamation shall have been fully completed. The attendants are also to observe certain obvious restrictions as regards intercourse with the outside world, clothing, and other minutiæ, with which we are all familiar. The sick-room must be properly and sufficiently ventilated, and not so hot as the patient's family are prone to have it for fear that the patient may "take cold." Scrupulous cleanliness about the body-linen and bed-clothing is to be strictly enjoined. The diet should be a liquid and easily-digestible one, suitable to the age and the condition of the patient. If the attack be a mild one, stimulation can be dispensed with; but when it threatens to be severe or prolonged, I do not wait until my patient is debilitated before resorting to stimulants, but I at once begin with them, in order to counteract any such tendencies, and continue their use, until convalescence has been firmly established. I employ alcohol, preferably in the form of whiskey or champagne, and augment its action by the exhibition of digitalis and sparteine sulphate. These two last-named remedies I often combine in the same menstruum, allowing from two to five drops of the tincture of digitalis and from one-sixty-fourth to one-tenth grain of the sulphate of sparteine, for instance, in a drachm of camphor-water every three or four hours. Sometimes, when great prostration is imminent, I prescribe the aromatic spirits of ammonia, in addition to the other cardiac stimulants, in doses of from three to twelve drops in a teaspoonful of water, every fifteen minutes, until the patient shall have revived. In such cases the food is also administered in as concentrated a form as possible.

The ordinary disturbances of the nervous system dependent upon the presence of fever, the common antispasmodics, as the bromides and the like, will control.

To allay the itching of the skin I have at times employed inunctions of feebly-carbolized white vaseline. But it has often been a question with me whether it did not interfere with desquamation and retard the necessary activity of the skin. I have therefore often substituted for them, when desquamation began, a course of mildly antiseptic tepid baths, either carbolated or sublimated, which seemed to me to hasten the desquamative process, and to produce a healthier action of the skin.

When the eruption is faint or tardy in its appearance, or when it shows a tendency to fade away, in the vernacular "to strike in," I have resorted to warm baths, to which mustard has been added, and to the application of sinapisms to the various portions of the body which appear to be the palest; besides which, ammonia is administered internally. In the majority of cases the eruption then resumes its brilliancy.

The patient must be confined to the house, even in the very mildest type of scarlet fever, and must be protected against all exposure to the vicissitudes of the weather.

The general management of the patient, after having passed through the attack, will, from the nature of the case, consist mainly of tonic and sustaining measures, coupled with a proper observance of hygienic principles.

A PLEA FOR A GENERAL ADOPTION OF PERSONAL PROPHYLAXIS IN DIPHTHERIA.

BY A. CAILLÉ, M.D.,
New York.

THE general recognition and acceptance of the principles governing antiseptic wound-treatment has given a new stimulus to the study of disease-prophylaxis, the importance of which seems to me sufficient to make the theme one of interest, particularly to members of this Society; and it is the thorough conviction of the importance of *individual prophylaxis* which prompts me to invite your consideration and earnest criticism of the practical points involved, as expressed by the title of this paper.

Diphtheria, in its various phases, is one of the most dangerous maladies which the physician is daily called upon to combat, and one over which we have no positive methods of control, when we face it, after it has found a firm foothold. At the present state of our knowledge every so-called specific treatment for diphtheria is an illusion, and I believe the time has come when the profession is prepared to admit to the public that the best and only treatment of a case of diphtheria is entirely symptomatic.

Holding in mind these facts, and taking into consideration the high mortality from diphtheria, we can all agree that preventive measures against diphtheria are imperatively demanded.

By the cultivation and simplification of preventive measures we may in the future triumph over infectious diseases. It is in this direction that the medical profession will be powerful for good, and the intelligent physician will come to an understanding with himself as to his duty in preventing diphtheria when he can and treating it where he must.

The duty of guarding the public health against the inroads of disease in municipalities is intrusted to sanitary officials; and the isolation of the sick, the use of disinfectants, and the general measures of the sanitary police are adapted to this effect.

For a number of years past the writer's experience has led him to believe that the municipal control of diphtheria in large cities is inadequate, and that in educating the mass of the people in the adoption of personal or individual prophylaxis more good can be accomplished than by the enforcement of sanitary laws alone.

Every person familiar with public matters in the city of New York will admit that for a number of years past good work has been done, in crowded quarters of the city, by the Board of Health, and that the Board has carried on a very effective warfare against the usual sanitary defects apt to be encountered in busy centres with a large permanent and floating population, and no one will doubt that lives have been saved, that suffering has been lessened, and that the health of the city has thus been promoted. The reconstruction of old and unhealthy abodes, the erection of tenements with air-shafts, ventilators, and lighted rooms, the supervision of our water-supply and house drainage, the isolation of the sick, the disinfection of infected apartments and localities, the compulsory abatement of nuisances, and prevention of filth accumulations, etc., have brought about a better sanitary status in New York City within the last ten years than would obtain without the efforts of our Health Board.

Through the courtesy of Dr. J. S. Nagle, of the Board of Health, I am able to show you a list of deaths from diphtheria for the past fifteen years.

DEATHS FROM DIPHTHERIA, NEW YORK CITY.

1873	1151	1881	2249
1874	1665	1882	1525
1875	2329	1883	1009
1876	1750	1884	1090
1877	951	1885	1325
1878	1007	1886	1727
1879	671	1887	2167
1880	1390	1888	1914

You will notice, at the first glance, a steady decline in the figures from 1881 to 1887. Now, notwithstanding this decrease in the mortality from diphtheria, which appears more marked when we take into consideration that in 1873 New York's population was 1,025,000, and that at present it is 1,500,000, we are painfully aware that the mortality from diphtheria is still very great. And how can it be otherwise? The power of our health authorities is limited, and it may never come to pass that we can compel people to keep their bodies, clothes, rooms, and surroundings clean, or compel them to destroy filthy carpeting and bedding, and to exclude from dingy and cramped apartments pet animals and birds, or that we can properly isolate all those sick with diphtheria or prevent parents from nursing their sick and attending to the well at the same time.

Owing to the peculiar nature of the diphtheritic poison, we cannot rely on its wholesale destruction or dilution any more than we can rely upon the municipal control of infectious wound-disease. A good surgeon will find it possible to secure aseptic healing of a wound in filthy and infected surroundings and localities by directing his efforts to the person and parts liable to be infected, and our endeavors to check and prevent diphtheria must of necessity lie in the same direction, although tempered with the full understanding that methods of occlusion, such as antiseptic surgical dressing, are not applicable to the usual sites for diphtheritic localization.

In recognizing the inadequacy of municipal control, we may well put the question, under the various circumstances and chances of infection in a large city, What can the individual do to protect himself, and those dependent upon him, from diphtheria?

A definite knowledge of the nature and exciting cause of an infectious disease enables us to direct our preventive measures intelligently.

Diphtheria is an infectious disease, which localizes itself in the most accessible mucous membrane of the naso-pharyngeal and upper respiratory tract. All modern authorities agree that it is beyond a doubt, primarily, a local disease, and that a hyperæmic and defective mucous membrane favors its localization. It is of prime importance to hold fast to this point, and to disregard entirely the misleading arguments of those, who, in failing to detect in a few cases on examination a prominent local deposit, speak of diphtheria as a constitutional disease with secondary mucous membrane exudation.

The investigations of competent observers show us with reasonable certainty that diphtheria is due to the invasion of a micro-organism which provokes tissue necrosis and the formation of a ptomaine which enters the circulation and produces constitutional effects. This point also we must hold in mind, and although it would appear that, according to the investigations of Löffler, Oertel, Prudden, and many others, there may be some difference of opinion as to the precise micro-organism or organisms which play the pernicious *rôle*, still they all agree as to the corpuscular character of the poison. It is furthermore understood that, (1) a hyperæmic mucous membrane offers favorable conditions for the development of diphtheria; and (2) that different forms of micro-organisms, identical in appearance with those supposed to be pathogenic, are found in the naso-pharynx in individuals in good health, and thrive in naso-pharyngeal mucus.

Now, bearing this in mind, we shall certainly follow a rational course if, in attempting to prevent diphtheria, we direct our efforts towards keeping in a healthy condition the mucous membranes usually affected, and in avoiding the accumulation of catarrhal secretions.

These more or less theoretical considerations led the writer, some years ago, to experiment as to the feasibility of personal prophylaxis, with special reference to those individuals who are prone to contract diphtheria several times a year, without apparent exposure, and whose infection might be looked upon as an auto-infection, due to the continuous presence of the diphtheritic poison in carious teeth, tonsillar crypts, and inspissated mucus, etc., upon the mucous membrane of the nose, pharynx, tonsils, base of tongue, etc.

These experiments were reported to the New York Academy of Medicine January 19, 1888, and published in the *Medical Record*, February 18, 1888.

My investigations extended over a period of two years, and consisted, to be brief, in subjecting a number of children and adults, who had notoriously suffered from diphtheria frequently, to a preventive treatment, consisting of gargles and nasal insufflation of harmless antiseptic solutions several times a day, a reduction of enlarged tonsils, and the proper treatment of carious teeth by a competent dentist.

About thirty individuals were originally included in these experiments, but in only ten cases did I succeed in carrying out the details of personal prophylaxis to my entire satisfaction, as far as obedience to my instructions were concerned.

Thus the communication quoted deals only with the results obtained in ten cases. All the other cases were dropped from the list and no results noted, owing to disinclination or lack of energy and perseverance on the part of the individual, or other circumstances beyond my control.

The result of the preventive measures employed may be summed up in a few words. The ten persons experimented upon, who had suffered repeated attacks of diphtheria prior to October 1, 1885, did not have diphtheria at any time from October 1, 1885, to December 1, 1887. For further details I must refer you to the original report.

I was decidedly impressed with the possible importance of this observation, and determined to test this matter still further, and also to induce others to experiment likewise.

During the past five years I have introduced this method into a number of families with children, and I am personally convinced that cases of diphtheritic infection have been prevented thereby.

I have abstained from presenting you with another table of cases, because it is difficult to keep up a perfect control for a sufficient length of time, and, furthermore, the mere production of statistics will not carry conviction as to the points raised.

Such experiments can and should be made by all who come in frequent contact with cases of diphtheria. The result can be estimated and will carry conviction one way or the other; and no amount of theoretical argument pro and con can establish or destroy the feasibility of the procedure.

After the publication of my report, I was pleased to note its favorable reception in certain quarters. Among other communications, I received one from Dr. Edson, of the Bureau of Contagious Diseases, drawing my attention to a paragraph in the Health Board's instructions for disinfection, which was suggested by my paper, and which reads: "Persons in contact with patients sick with diphtheria should use disinfectant gargles under the direction of a physician." My attention was also drawn to an article in the St. Petersburg *Medical Weekly*, No. 37, 1887, by Johannsen, who advises that a weak solution of potassium permanganate should be dropped into the nostrils of children every night. He claims to have practised this method for some time, and is firmly convinced of its value.

During the course of my investigations, I have made a number of observations which corroborate many of the views expressed in this essay. As regards an injured mucous membrane being a predisposing factor in diphtheritic infection, I would state that I have known diphtheria to follow cauterization in the throat and nose with nitric or sulphuric acid, or the actual cautery especially, in persons liable to sore throat; and such cauterization was followed by fever, glandular swelling, and a pseudo-membranous deposit not to be distinguished from a diphtheritic membrane.

I have furthermore observed that persons afflicted with heart-disease and other forms of faulty circulation—in short, persons whose mucous membranes are frequently cyanotic and hyperæmic—are very apt to contract diphtheria. I particularly remember a girl afflicted with mitral stenosis and insufficiency, who was a frequent sufferer from diphtheritic sore throat, and who after systematic gargling and insufflation did not take sick with diphtheria in three years. In the early part of the year 1888 she was confined to bed for two months on account of heart-failure and pulmonary congestion, and, being too ill to pay the necessary attention to her nose and throat, the preventive treatment was abandoned for a time. In the fifth week of her confinement in bed, while her general condition was good and her temperature normal, she developed genuine diphtheria, and became quite ill for a week.

Any one who will make it a rule to inquire will find that in most cases nasal or naso-pharyngeal catarrh, filthy gums, and carious teeth had existed for some time prior to the diphtheritic onset. Scarlatina, measles, and pertussis are predisposing factors to diphtheritic infection, owing to the congested condition of the mucous membranes in those diseases, and *preventive measures to the nose and throat are the most important factors in the treatment of such cases;* for it is a well-known fact that many children fall victims to diphtheria secondary to scarlatina, measles, or pertussis, although there may have been ample time to apply preventive measures before diphtheria was at all manifest.

Recent bacteriological investigations have shown more than twenty forms of bacteria in the naso-pharynx and buccal cavity of persons in ordinary good health; even the streptococcus, which is looked upon by Prudden as the true cause of diphtheritic inflammation and tissue necrosis, has been found in the mouths of persons exposed to diphtheria, but not actually sick. On the other hand, it has been shown that it is quite possible to sterilize or disinfect the naso-pharynx and mouth, and, if not really to destroy, at least to hinder the development of dangerous germs.

I here show you a list of substances which have been tested as to their antiseptic properties in the buccal cavity, their antiseptic power being expressed in figures.

TIME NECESSARY TO DEVITALIZE BACTERIA OF MOUTH AND NASO-PHARYNX.

The results will be seen in the adjoined table. In the first column are given the antiseptics, and in the second the time of exposure necessary to a complete devitalization :

Salicylic acid	1–100	¼ minute.
Benzoic acid	1–100	¼ "
LISTERINE, PURE		¼ to ½ minute.
Salicylic acid	1–200	½ "
Benzoic acid	1–200	1 to 2 "
Bichloride of mercury	1–2500	½ to ¾ "
" " "	1–5000	2 to 5 minutes.
Eucalyptus	1–200	5 to 10 "
Peroxide of hydrogen, ten-per-cent. solution		10 to 15 "
Carbolic acid, one per cent		10 to 15 "
Oil of perpermint		10 to 15 "
Permanganate of potash	1–4000	over 15 "
Boracic acid	1–50	" 15 "
Oil of wintergreen		" 15 "

W. D. MILLER, A.B., PH.D., D.D.S, Berlin.

The substances which I have employed are watery solutions of salt, alum, boracic acid, soda chlorinata, potassium permanganate. I do not claim that an insufflation into the nose twice a day, and gargling and rinsing three times a day, will sterilize the parts, but I do claim that by such procedures putrescible matter is carried off, and its accumulation together with the development of disease-germs prevented. Finally, I would state that I have never known otitis to result from the insufflation of lukewarm, non-irritating solutions, especially if the mouth is kept open during the procedure.

The reduction of large tonsils can be done with the knife or cautery, and is neither difficult nor injurious. The removal of bad teeth in children, or the temporary preservation of children's carious teeth with an easily-applied cement, demands the service of a dentist.

After my first communication on personal prophylaxis, I was told by some of my professional friends that the measures advocated were good, but too troublesome to carry out, and therefore not practical.

To this I would simply reply that if parents, who love their children, are told by competent and earnest physicians that they may possibly prevent diphtheritic infection by keeping the teeth, mouth, and nose in good order, they will be thankful for such information, and faithfully carry out a treatment which involves so little actual labor. That the indolent, ignorant, and shiftless will take no interest in such matters is an argument not deserving of serious consideration.

In closing this plea for a general adoption of personal prophylaxis in diphtheria, I will quote a few words from Dr. J. L. Smith's article on diphtheria in the "Cyclopædia of the Diseases of Children," vol. i. p. 655. After referring at length to Dr. A. Jacobi's views regarding the relation of diphtheria to follicular tonsillitis, and his early and persistent advocacy of preventive measures, he says, "In a report to the New York Academy of Medicine, Dr. A. Caillé expressed the belief that he has prevented the recurrence of diphtheria in those who have suffered repeated attacks of it by prolonged daily antiseptic treatment of their exposed surfaces, which harbored the poison or constituted a nidus favorable for its lodgement and propagation. These somewhat novel views of Drs. Jacobi and Caillé certainly require consideration and experimental testing."

I can only add that nothing would give me greater satisfaction than to see the suggestion of Dr. J. Lewis Smith, as to experimental testing, carried out by this Society and its members.

DISCUSSION.

Dr. Fruitnight said that the first case of the disease which appears in a family usually dies, because the parents were not familiar with the symptoms, nor with the ofttimes insidious character of the onset of the disease. He had instructed the mothers to always examine the children's throats every morning just as regularly as they make the children's toilets, in order to inform themselves whether any abnormal condition might be present. Of course the mothers are taught to distinguish the ordinary appearances of the throat in health. If there be any appearance of deviation from that standard, some simple measures are used to cure it; if more severe symptoms are apparent, the physician is summoned. In this way, I think, I have been able to effect something in the way of at least mitigation, if not prevention, of diphtheria.

Dr. Earle would be glad to get the physicians to do what Dr. Fruitnight wished the mothers to do.

THE NECESSITY OF PROLONGED REST AFTER SOME ATTACKS OF DIPHTHERIA.

BY CHARLES WARRINGTON EARLE, M.D.,
Chicago.

It is probable that a larger number of sudden and unexpected deaths take place after diphtheria than follows any other disease. And yet we are acquainted with medical men who do not believe it worth the while to isolate those sick with this malady, and think their responsibility ceases when the white spots commence to disappear in the throat. The following is a hypothetical case, but is there a gentleman present who has not seen one or more which corresponds with it?

A. B. C., aged six years, was taken with a mild attack of diphtheria, which yielded easily to treatment in five days. The spots on the tonsils had nearly disappeared, and I discontinued my visits. Ten days after, I was hastily summoned, and, upon my arrival, found the child dead. The parents informed me that the little one had made an excellent recovery from the diphtheria, and, although somewhat weak and easily tired, had been playing around the house. "A short time before we summoned you we noticed that the little one was quite pale, and complained of a little pain around her heart. She perspired freely, however, and we thought nothing of the pallor; but her limbs began to get blue and her breath short, and so we sent for you."

Death certificate reads apoplexy or heart-disease.

Not all cases are as pronounced and sudden as the one narrated; but death comes. Sometimes we have premonitory symptoms, if we will note them, and if we will take any sort of notice, death may be averted in some cases. I have recently ordered a young woman to maintain the horizontal position for ten weeks, and during some of this time her heart was so irregular and weak that its pulsations could not be counted. I saw a case recently in consultation with my colleague, Professor Quine, simply to add my testimony to his, that the only safety to a young girl who had passed through a mild diphtheria was in bed. Her heart was slow and weak, and the extremities were a little subnormal as regards temperature. The people were amazed when I told them that the child should be kept in bed for at least four weeks, and possibly a longer period.

Two months ago I saw a case, in consultation, in one of our suburban towns (we have no suburbs now,—we have taken them all in). An adult had only a moderate pharyngeal diphtheria, but his lungs were involved, probably a catarrhal pneumonia (secondary). He was very weak, but his recovery could be looked for, although a long time must elapse before he could resume work as a bank clerk. His attending physician had given him excellent advice, but everybody was clamoring for a speedy cure. It is sometimes very difficult to make the people understand the necessity of carrying out details, particularly those which the profession have not grasped and fully realized. Notwithstanding that this young man was kept in the lying position,—fed with food whose assimilation was made as easy as possible,—nourished by rectum and under his skin,—life maintained by general, cerebral, and cardiac tonics and diffusible stimulants,—notwithstanding all this, he died.

I cannot undertake to discuss the pathology of these cases. It was not my intention, even if I fully understood it. What I desired to do was to call attention to these cases, and to obtain the endorsement—the influence—of this Society, so that we can go before the great general profession and say that these cases need more than a goose-quill and sulphur treatment.

Personally, it seems to me that it is a muscular failure. We all notice the rapid and terrible emaciation in these cases, —the general muscular failure and weakness. The heart as a muscle, in my judgment, suffers in like manner. Whether there is a fatty degeneration I do not know, but the heart cannot do its work. We have in most cases symptoms which point to some form of paralysis. It may be in the throat, the soft palate, or an unusual muscular weakness. It may be in a very slow or a very rapid pulse, or in irregularity.

We should not neglect it. It means more than we have been accustomed to acknowledge,—at least more than the majority of the profession seem to acknowledge. In some families, where they are willing to go to the trouble, I am in the habit of keeping all diphtheritic patients in bed two or three weeks after all symptoms subside.

This may not be necessary, but it is safe. It is absolutely demanded, however, where symptoms of paralysis are present, and should be insisted upon till every sign denoting it has disappeared.

No definite time can be named when this precaution should cease. It may be four weeks, and it may be four months; and in a case to which I refer in another paper, it was one year, and demanded not only ordinary care and treatment but life in the country.

The indications for treatment in these cases are from first to last the recumbent posture,—not to be relinquished for any purpose; the best and most nutritious diet introduced in every possible manner; the nerve tonics—strychnia and nux vomica and electricity—associated with general tonics and stimulants; but placed before everything else and insisted upon is the recumbent position.

DIAPHRAGMATIC HERNIA WITH OPERATION.

BY J. O'DWYER, M.D.,

New York.

THE history of the following case of diaphragmatic hernia was furnished by Dr. Lynde, the resident physician to the New York Foundling Hospital:

Eddie B., aged three and a half years, first seen November 20, 1888, at which time he was reported as having been sick four days. The symptoms were severe dyspnœa, marked prostration, temperature 105°, no movement from the bowels in two days. Physical examination showed flatness over posterior portion of left chest with absence of respiratory sounds. Moderate dulness anteriorly, with broncho-vesicular breathing at upper part. Resonance having a somewhat tympanitic quality about sixth intercostal space in axillary line. Heart displaced to the right with apex beat most distinct in the epigastrium. Dr. Lynde, feeling confident that the case was one of empyema, inserted a needle in three different places, with negative result. Eight days later, the bowels having been freely evacuated by cathartics, the temperature is recorded as normal with absence of dyspnœa; but the general condition remained poor, and no change in the physical signs. He was allowed to be up and about, but was fretful and irritable and had a habit of frequently holding his hands to his sides.

December 16. Another similar attack is noted, with high temperature and urgent dyspnœa.

From this until the 15th of January, 1889, when I first saw the case, there had been several attacks in which the temperature ranged from 102° to 106°, with extremely rapid, feeble pulse and urgent dyspnœa. During the worst of these attacks, which always coincided with constipation, the little patient appeared to be in a dying condition, but a brisk cathartic always brought relief, until the day before I saw him, when no improvement followed a free evacuation.

When I examined the case there was flatness on percussion, with absence of breathing-sounds everywhere over the left chest, except in the region of the apex anteriorly, where there was a moderate degree of resonance, with feeble respiratory murmur. The circumference of the left side measured three-quarters of an inch more than the right, and the heart was in the position noted above. I had no hesitation in pronouncing it a case of empyema with very large effusion.

We therefore inserted a much larger needle than that used on the first occasion, with the intention of drawing off a portion of the fluid, in order to allow the lung to become partially re-expanded before opening the pleural cavity. Nothing being obtained with this, a long trocar of still larger calibre was inserted and the aspirator applied, with same result. The distal end of the instrument, which was pushed in a distance of two or three inches, could be moved freely in all directions, proving that it was in a large cavity and not in a solidified lung or neoplasm.

As the real condition was not suspected, we naturally concluded that the pus was too thick to run, and made an opening in the sixth intercostal space, between the axillary and mammary lines. Something having the appearance of intestine blocked up the wound, which was then enlarged, and the cavity explored with the finger. The patient gave a slight cough as I withdrew my finger and forced about six inches of the small intestine through the opening, which we found considerable difficulty in replacing. It was found necessary, for this purpose, to insert retractors above and below, and use considerable force in order to separate the ribs. The wound was closed and compress with bandage applied.

The question now came up as to the feasibility of returning the intestines to their proper place, and making an attempt to close the rent in the diaphragm.

As the pleural cavity was already opened and air admitted, it was concluded that another opening, lower down, and large enough to admit one or two fingers, in order to determine the size and location of the rent, would not materially change the outlook for the patient.

Should it be found favorably situated, and not too large to offer a reasonable prospect of bringing the edges together, the external wound could be enlarged by removing a portion of the ninth and tenth ribs, which would give ample room to work in, as previously demonstrated on the cadaver.

The following day, January 16, assisted by Dr. W. P. Northrup and Dr. Lynde, I made an incision about two inches long in the tenth interspace, and found the aperture to be situated in the muscular portion of the diaphragm, about one inch and a half in diameter, the external margin reaching close to the ribs.

I then removed about three inches of the ninth and tenth ribs, and by drawing down the floating ribs, ample room to insert the whole hand, if necessary, was obtained. Considerable difficulty was experienced in replacing the intestines, owing to the small size of the peritoneal cavity, from retraction of the abdominal muscles. The cæcum and some of the omentum were the last parts reduced.

To prevent a return of the intestines while paring the edges of the wound and passing the sutures, two flat sponges, attached to holders, were found necessary. Strong braided silk was used for this purpose, and six sutures inserted. When the diaphragm was allowed to resume its position, after the completion of the operation, the pressure from below was so great that it bulged upward, so as to fill at least half the pleural cavity. The hernia being probably congenital, and the whole mass of intestine, with the exception of the descending colon, having occupied the chest so long, there was not sufficient room for them in the abdominal cavity.

An attempt was made to relieve the great strain on the sutures by packing in some antiseptic gauze and closing the external wound around it, but without avail.

Death occurred rather suddenly six hours after the operation, at the very time that he appeared to be doing well.

At the autopsy the edges of the wound in the diaphragm, as seen in the specimen (exhibiting specimen), were found somewhat separated, and in all probability the sutures would have cut completely through in twenty-four hours, had the patient lived so long.

The left lung was extremely small, apparently undeveloped, and collapsed; but all parts of it still contained some air.

The mediastinum was crowded so far over that the right lung was very much compressed, and contained a deep indentation or mould of the heart.

No mesenteric attachment existed below the cœlic axis, the descending colon alone being normal in this respect.

There are several points of interest connected with this case. (1) the fact that the physical signs were identical with those of empyema; (2) the frequent high temperatures, for which there was no apparent cause except constipation; (3) the futility of operation in diaphragmatic hernia of long standing, in which such a large mass of the intestines occupy the pleural cavity; (4) that the point of election for operation is through the thorax in preference to laparotomy. The upward arching of the diaphragm, which is augmented by opening the peritoneal cavity, must render the latter procedure very difficult.

The removal of a portion of two ribs made such a large opening that the whole pleural cavity was illuminated, even to the apex. The contracted lung and the pulsations of the heart could be distinctly seen. The mediastinum was pushed so far to the right that the left pleural chamber appeared to be large enough to occupy the whole thorax.

Recent and especially incised wounds of the diaphragm, which are usually situated near the periphery, can be reached and sutured by a free opening in the tenth or eleventh intercostal space, the floating ribs being so movable that they can be easily separated to a considerable distance. This was demonstrated by a case operated on by Professor Postemski, of Bologna, on the 4th of last March.

The following abstract of the report of this case was taken from the *Medical News* of June 8, 1889:

"The patient was a boy, aged fourteen years, who received a stab-wound two centimetres long in the eleventh intercostal space, on the left side in the posterior axillary line. The omentum protruded from the wound to a length of five or six centimetres. Professor Postemski enlarged the wound by twelve centimetres, and forced the eleventh and twelfth ribs widely apart, bringing into view a large part of the vault of the diaphragm, in which a wound one centimetre and a half was seen. The protruding omentum was tied and cut away, the stump being pushed back into the abdomen. The edges of the diaphragmatic wound were brought together with silk sutures passed through the whole thickness of the muscle. The pleural cavity, which contained clots of blood, was washed out, and the wound in the chest wall was closed with deep sutures, no drainage-tube being used. After the wound was closed emphysema of the whole left side of the chest, up to the neck, came on, but in less than a fortnight both pneumothorax and emphysema had disappeared. The patient was presented at the Roman Academy of Medicine three weeks after the operation, completely cured."

DISCUSSION.

Dr. Holt.—As bearing on the difficulty of diagnosis, I would cite the case of a man who came under my observation, on whom a chimney had fallen, and who, after the second or third day, presented symptoms and physical signs which were supposed to be pneumothorax. There was absence of respiratory murmur, tympanitic percussion resonance all over the left chest, with displacement of the heart and of the other viscera. The autopsy showed traumatic rupture of the diaphragm, with the colon and a large part of the small intestine in the thoracic cavity.

Dr. Vineberg.—In regard to the symptoms, I recall a case in which the temperature went up to 106° F. from constipation, and subsided after evacuation of the bowels.

ACUTE PERITONITIS FOLLOWING VULVO-VAGINAL CATARRH IN A GIRL SEVEN YEARS OLD, SIMULATING A PERFORATION OF THE APPENDIX: LAPAROTOMY: DEATH.

BY FRANCIS HUBER, M.D.,

New York.

In view of the difficulties attending a correct diagnosis and the rarity of the complication at this early age, the following case is interesting and instructive:

The patient, a girl seven years of age, had been troubled with a vaginal discharge for a short time. She was an exceedingly anæmic child, and though frail, did not complain much. Usually constipated; appetite poor. The vulva was inflamed, and a few drops of pus about the urethral orifice; the vaginal flow greenish and quite abundant. The hymen was intact; no evidences of violence about the genitals. Close questioning failed to discover any cause for the vulvo-vaginal catarrh. Unfortunately, an examination of the discharge for the characteristic coccus was not made. For a few days the patient was treated at the office. Some soreness about the lower pelvic regions, together with general weakness, made her take to her bed. The following day, June 1, she vomited once, a little blood being mixed in with the contents of the stomach. A little soreness over the pubes present upon abdominal palpation. The pulse was good; no distinct pain; a little diarrhœa (though constipation was the rule); temperature (rectal) normal. The little one, at this visit was laughing and in excellent spirits, though very weak. At the evening visit, the picture had changed for the worse, and the patient was in collapse. This condition had set in a short time before. The temperature was now subnormal, pain in the right iliac fossa marked, with muscular rigidity of the same side of the abdomen; vomited a number of times. Taking into consideration the rather sudden onset, the collapse with subnormal temperature, and the pain in the right inguinal region, with the attending digestive disturbance and the prior history of constipation, I was inclined to suspect a perforation of the appendix vermiformis. A few hours later Dr. Charles E. Denhard (June 1) saw the case, and took the same view. The following morning (June 2) difficulty in urinating, attributed to an existing pericystitis, was noted. The child had rallied from its collapsed condition, and was certainly improved; vomiting less. Professor A. Jacobi was called in consultation, and, for the reasons above referred to, confirmed the diagnosis. As the urine had not been passed since the preceding evening, it was drawn off, and found free from albumen. The vomiting soon reappeared, and quickly became greenish; tympanites set in and became more marked; abdomen generally more tender, pain more and more severe in spite of morphia. The pulse grew more frequent and weaker; general condition bad. The next day (Monday, June 3, 5 P.M.) Professor Wm. T. Bull was called in consultation. The diagnosis of acute general peritonitis, due probably to perforation, was endorsed. A laparotomy was advised, the dangers of the case being fully explained to the family. Temperature (rectal), 101; pulse, 150 and very weak; vomiting incessant, and not influenced by any of the numerous remedies resorted to.

Eight hours later (1 A.M., June 4) the parents finally consented to an operation, though they were informed the case was desperate, and the prospects of ultimate success were not very encouraging. Chloroform was cautiously and skilfully given by Dr. Denhard, and Dr. Bull opened the abdomen by a lateral incision over the colon. Considerable sero-purulent fluid was found in the peritoneal cavity; the intestines were distended with gas, congested, and here and there coated with lymph. The appendix was sought for, and found after some difficulty. It presented a perfectly normal appearance, and no fecal concretion or foreign body could be detected through its wall.

The right fallopian tube, however, with its fibrillated extremity was inflamed and thickened, and evidently had formed the channel by means of which the infecting process had gained entrance to the peritoneal cavity and thus gave rise to a train of symptoms simulating closely a perforation of the appendix. The true character of the case was only revealed at the time of the operation. The abdomen was now washed out with hot water, the wound sewed up, and an antiseptic dressing applied. A rectal injection of hot water and brandy was then administered, and the patient put to bed, with the head low. The operation apparently did not add any further element of shock to the unfavorable condition of the child.

Twenty hours later death occurred from heart failure, the pain and vomiting persisting to the end.

F. Spaeth (*Münchener Medizinische Wochenschrift*, February 28, 1889) raises the interesting question whether, in children, there is danger of the specific inflammation extending from the vagina to the uterus and tubes. In general, the trouble is limited to the lower portion of the genital tract, although a few cases of pyosalpinx, of gonorrhœal origin, have been reported. Sänger has met with an instance in a girl three and a half years old, who developed intense peritonitis in consequence of gonorrhœal infection. He believes that cases of pyosalpinx and old localized peritonitis in young virgins might possibly be referred to gonorrhœa contracted in childhood.

A. F. Currier, in an article on "Vulvo-Vaginitis in Children" (*Medical News*, July 6, 1889), says, "In adults, this disease not unfrequently extends to the uterus, the fallopian tubes, the ovaries, and the peritoneum, and may end fatally. I can find but one recorded case in which such an extension occurred in children; but it seems to me extremely probable that many of the deformed and undeveloped uteri, with which are associated so much dysmenorrhœa and anguish, sterility, and domestic unhappiness, are the legitimate consequence of vulvo-vaginitis in early life."

Some time ago I saw, through the courtesy of Dr. A. W. Newfield, a girl eleven years old, with an acute illness, whose chief complaint was intense pain in the right groin with difficulty in urinating, some vomiting, and tenderness with rigidity of the right side of the abdomen, the right thigh being flexed upon the abdomen.

The existence of a severe vaginal catarrh put us on our guard, and a vaginal examination revealed an absence of the hymen, and an inflamed and exquisitely tender ovary.

Hadfield (ARCHIVES OF PEDIATRICS, 1886, p. 64) reports a case resulting in peritonitis.

In the case presented, the rather sudden onset with the prior digestive disturbances in a patient generally constipated, with collapse, subnormal temperature, intense pains in the right iliac fossa, with rigid abdominal muscles on the same side, and the rapid occurrence of acute general peritonitis, certainly justified the diagnosis of perforative appendicitis with general peritonitis. The vulvo-vaginal catarrh, though severe, did not appear to me to enter at all into the etiology of the case. From the rarity of the complication at this early age, I failed to appreciate the importance of the vaginal inflammation as a possible factor, and also failed to interpret correctly the import of the pelvic soreness complained of early in the case. Though it was not possible to establish the source of the infection, the vulvo-vaginitis was probably gonorrhœal, for the process involved the urethral mucous membrane,—an extremely important diagnostic point.

In twenty-one cases occurring in girls between the ages of three and eleven years Spaeth found Neisser's coccus in fourteen, and in all of these the inflammatory process extended to the urethral mucous membrane. He gives it as his belief that all cases of vulvo-vaginal catarrh in children, in which the urethra is involved and the gonococcus of Neisser is present, specific infection has occurred.

DISCUSSION.

DR. CAILLÉ.—I have seen one case five months of age. The father had gonorrhœa. The infant had ophthalmitis and also vulvo-vaginal catarrh, and finally developed peritonitis, from which it died.

DR. KOPLIK.—Sänger, of Leipsic, traces the cases of pyosalpinx occurring in young girls to vulvo-vaginal catarrh of infancy. This would seem to explain some cases in adult life which we cannot explain in any other way.

TUBERCULOSIS OF THE TESTIS IN CHILDHOOD.

BY HENRY KOPLIK, M.D.,
New York.

TUBERCULOSIS of the testis during infancy and childhood, as a primary manifestation of tuberculosis, is a field but little explored. Isolated cases of this disease are found in our literature, and a paper which will attempt to collect such cases and literature is certainly timely.

The first case reported, which I shall refer to, we find in the clinic of Hennig. This case was described by Robert Bahrdt.

Patient, æt. three and three-quarters years; in the service of Professor Hennig, 1870. In July, 1869, a swelling in the right scrotum was noticed; this became red; the epididymis and testicle became swollen; an abscess formed in the anterior aspect of the testicle; this opened and left a hardness. The abscess, after discharging, closed and did not reopen. The child died of secondary tuberculosis of the cerebellum, a tubercle, the size of a cherry, being found in this organ.

R. Demme, in a report of the Jenner Children's Hospital, reviews a collection of nineteen hundred and thirty-two cases of tuberculosis. Of these, sixteen presented the first symptoms of tuberculosis in the epididymis. In eight hundred and twenty-three cases, in which the disease first localized itself in the bones and joints, five developed tuberculosis of the epididymis.

E. H. Monks records a case of an infant, aged five months, who at first had an enlargement of the right testicle; the enlargement was painful, the spermatic cord was thickened and contained some hard nodules. In the left ischio-rectal fossa there was a distinct fulness as if an abscess were forming. Though the conclusion was that an injury had caused both phenomena, there was no history of the same. The ischio-rectal swelling developed into an abscess from which two drachms of pus were evacuated. The testicle continued to enlarge, the skin on the posterior aspect became red, but there was no discharge. Infant died three months after first observation; the testicle alone was examined. On section, the posterior part of the organ was found breaking down into abscess. There were nodules surrounded by testicular tissue; there were nodules in the cord. Dreschfeld, of Manchester, examined the testicle, and found embryonic tissue, detritus, giant-cells, and a few tubercle bacilli in the scrapings. He was of the opinion that scrofulosis (?) of the testicle was present and primary, and set up general tuberculosis.

P. E. Lannois is convinced that this disease is not so rare as is generally supposed. Giralde, according to this author, encountered it in the new-born infant. In one hundred and eighty-three autopsies of infants, Papavonie, Dufour, and Banier record tuberculosis of the testis only once.

Lloyd records a case of an infant three and a half years old; Prestat, an infant nine months; Dufour, eighteen months. Unhappily, the cases recorded by Lannois have not been followed up; they have only been seen in clinic.

Case I.—Infant five months old; right testicle affected; no other organ affected; hereditary history.

Case II.—Right testicle, infant seven months old.

Case III.—Infant thirteen months old; left testicle; hereditary history.

In Case I. the father had a cough and night-sweats for months. In Cases II. and III. the father was also affected with a cough for a long period.

Gevaert asserts that tuberculosis is rare in the infant up to the sixth year of life. Gosselin and Walther also assert its rarity (Jacoud, "Nouveau Dictionnaire de Médecine," 1883, t. xxxv. p. 296); these cite a case three and a half years of age. Lloyd records a case at eighteen months; Dufour, at nine months; Prestat, in an infant at term (Giralde). A. Dupres has met the disease in infants from the age of six months to one year. Gevaert's case is an infant eighteen months; left testicle tubercular; scrotum distended to the size of a hen's egg; the skin over the tumor is stretched and thin; the tumor, superiorly, presented fluctuations; inferiorly it is round, hard, and nodular. The various coats appear adherent to the testicle. The cord is swollen ; the testicle is painful when squeezed. The lungs free. The child has suffered from pertussis for a month past. Castration performed; good recovery. Macroscopically there was still some healthy tissue in the inferior part of the affected organ. The superior portion was riddled with abscesses. In these there was a creamy pus.

Professor Lammelongue, in Verneuil's "Studies upon Tuberculosis," records the following cases:

CASE I.—Child, æt. two months; right testicle tubercular, with a fistula into the epididymis; an enlarged nodular moniliform cord. The enlargement occurred just after birth, and terminated in fistulous openings. The region of the prostate and seminal vesicles on the right side affected.

CASE II.—Double tuberculous testicle at the sixteenth month. Began by an affection of the right testicle at two months, the little patient having previously suffered from a subhyoid abscess. The right testicle enlarged and more affected than the epididymis. It is unequal, irregular, and fused with the head of the epididymis. It is difficult to define both organs. The epididymis is also irregular, hard, and changed. The cord is affected. The left testicle equally enlarged. The epididymis and testicle can both be made out. Cord and skin not affected. Mother tuberculous.

CASE III.—Infant ten months old; noticed a month after birth. The epididymis and testis form a tumor the size of an egg. The two organs fused into each other. Tumor is regular, but it can be separated into three lobes. There are fistular abscesses. The cord is enlarged.

Author's case.

Child, æt. twenty-two months; was first seen February 14, 1889. Mother is a healthy, well-built woman, of German extraction. She has two other children, both of whom are in good health. The father of the child died six months ago with symptoms pointing to pulmonary phthisis and disease of the bones of the spine. The mother says the child has enjoyed good health until eight months ago, when she first noticed a swelling in the calf of the left leg; this swelling broke open and discharged. It has been discharging ever since. Two months subsequent to the appearance of the above, the testis on the left side began to grow larger in size, red, and a fistulous opening appeared at the summit of the swelling (anterior superior part of testis). This opening is still discharging pus. Seven weeks ago the little patient contracted whooping-cough, and has been coughing ever since. The convulsive seizures have ceased, but the cough persists. Child has for months suffered from a chronic diarrhœa. Has never had scarlet fever or measles.

Status.—The patient is somewhat anæmic, though well nourished; has an eczematous patch on the left side of the nose; the skin is otherwise free from eruption. The bones show signs of rachitic processes, also the head. The lymphatic nodes at the back of the neck—also those under the jaw and in the inguinal groove—enlarged.

Heart, normal signs. The lungs show behind rather a tympanitic tone to the percussion; subcrepitant râles heard over both sides.

Abdomen.—Examination gives negative results. The testis of the left side enlarged to the size of a small hen's egg; skin red and fairly adherent; tumor is uniformly rounded, not painful except upon very extreme pressure. What may be taken for the epididymis can be felt behind; on opening anteriorly and superiorly discharges a yellow thick fluid. The spermatic cord is swollen below; not nodular. The lymphatic nodes along the cord are much enlarged. The testis on the right side is of normal size and appearance, but the lymphatics on the right groin are also enlarged. There is a suppurating tract in the calf of the left leg, behind, at the junction of the lower and middle third. This is not at present discharging, though the history of the same shows that it does so at intervals. It leads into a district of tissue thickened and uneven; it is not possible to positively connect it with the bone. The scrapings from the sinus in the testis show tubercle bacilli in sparing quantity.

February 18. The fibular abscess has now begun to discharge. The opening in the affected testis also discharging; there is a small fungoid growth of granulations at the opening in the testis, not mentioned above.

February 23. The testis was removed by Professor Weir at the New York Hospital. The enlarged and diseased testis, when removed, was fully the size of a large walnut; a section through the fungus showed the interior an irregularly round portion surrounded by thickened skin and coverings, while behind the epididymis was seen. That part corresponding to the testis proper, on section, was mottled yellowish in color, the cut surface was uneven, and bathed in a yellow creamy fluid. In portions white punctate areas were seen. At the posterior inferior part of the tumor was a cavity filled with the above cheesy or creamy material; this was located, as far as could be made out, in the region of the epididymis; this cavity did not communicate with the discharging sinus exteriorly. The sinus in the calf of the leg was thoroughly explored, but it did not communicate with the bone. Its origin, at the operation, was supposed to be traumatic. Patient obtained complete union of wound.

May 1. Return of disease.

In the lower part of the cicatrix of the operation-wound there has appeared at first an incrustation, then an ulcer, and finally a deep linear ulcerating area, stretching in the direction of the cicatrix. About this time a small lump was felt in the lower part of the scrotal sac, on the operated side. The patient has had during the suppuration of this ulcer night-sweats but no cough; there is no emaciation. The condition of the patient is much better than before operation. The cervical lymphatic nodes are still readily felt, but the inguinal nodes are very small, less large on the diseased than on the operated side. An examination of the lungs shows absolutely no disease. In addition to the ulcer in the cicatrix, the scrotal lump shows on its summit two yellowish spots. The examination per microscope will be given below. Scrapings from the ulcer showed tubercle bacilli.

Dr. W. W. Van Arsdale extirpated the return of the disease, and obtained complete union all along the operated area, with the exception of a small millet-sized spot, which remained granulating at the discharge of the patient.

Here we lost sight of our case, the parents having migrated to Germany. Before departure, the little patient was reexamined. He was in very good physical condition, of good color, lungs perfectly free from signs other than normal. There was no cough or sweats; urine normal. Lymphatic nodes very small at the back of the neck; in the inguinal region, almost of normal size; smaller on the diseased side. The opposite side, both testicle and cord showed no signs of disease.

The microscopical examination of the removed testis divides itself into the appearances of the testis proper, the epididymis, the skin, and vas deferens.

The testis, on section, when hardened, had a uniform whitish appearance of cheesy consistence. In places, macroscopically, the tissue presented irregular openings, as if honeycombed; this appearance was caused by the shrinking action of the alcohol upon the softened cheesy areas. The mass of the testis showed under the microscope to be composed of small nodules or granula, aggregated together to form diffuse masses, taking up the greater bulk of the part assigned to the body of the testis. Some of these nodules were composed of small and large, round or polygonal, cells, which, when the section was shaken, were seen embedded in a net-work of fine reticulum of connective tissue. The central portion of most of these nodules (miliary in size) had undergone disintegration so that either only granules appeared or remains of nuclei. In the peripheral portions of some of these miliary areas, or tubercle granula, were situated two or more giant-cells. The central portion of some tubercle granula had simply a granular structure. The central zones stained a deeper violet with hæmatoxylin and eosin than the peripheral zones. The above describes what appeared as old miliary tubercle granula; those of recent eruption could be seen here and there scattered through the tumor mass. They consisted of a peripheral portion of concentrically arranged spindle- and polygonal-shaped cells; towards the centre were seen round and polygonal cells, in the midst of which were a number of large giant-cells. These apparently recent granula were very few in number, the whole mass of the testis being taken up by the great number of tubercle granula with cheesy centre or centre with detritus of disintegrated cells. The areas between these miliary granula or the masses of diffuse tubercle were taken up by connective tissue or spindle- and spherical-shaped cells.

In one spot there was a portion of the original tissue of the testis to be seen; in this the seminiferous tubules were shown to be the seat of a curious change by which, when stained, the nuclei of the lining epithelium and the whole tube were stained in a diffuse manner, giving the structures a hyaline appearance. In other places only the centre of the lumen of the seminiferous tubercles had a hyaline appearance, whereas the nuclei of the lining epithelium showed fairly well. The interstitial connective tissue of the tubules was largely increased, obliterating and pressing upon the lumen of the tubules in places. There were few blood-vessels to be seen in the area taken up with tubercle granula, but outside this the blood-vessels, in places, appeared the seat of obliterating changes, or their walls were infiltrated with small round cells. In places where tubercle granula were absent, there was a large amount of connective tissue, fibrillar in structure, with spindle or round cells, with a fibrilla basement substance; this, apparently, did not differ from connective tissue seen in chronic interstitial changes of other organs.

The coverings of the body of the testis are seen, on section, to be agglutinated so that they cannot be differentiated. The skin proper, however, is not involved with any changes, except for the presence of infiltration of small round cells, especially in the vicinity of the blood-vessels and the discharging sinus fungus. Some of the smaller vessels in the deeper layer of the skin and tunica vaginalis are the seat of obliterating changes; the area in the vicinity of such vessels is infiltrated with small round cells.

The epididymis.—(*a*) The interstitial connective tissue between the walls of the tubules was markedly increased.

(*b*) The walls of the tubules in some places had undergone remarkable increase in thickness by the apparent growth of connective tissue; the lining epithelium, however, in some of these tubules remained still intact, and the lumen of the tubule was filled with simple granular detritus, or free from change, or filled with small epithelial cells spheroidal with round nuclei, apparently spheroidal, because here the staining did not bring out the exact shape of these cells filling the lumen of the tubes, but in places where the tubes were not so fully packed with these cells, but only contained say six, their form was spheroidal with round nuclei.

(*c*) In other places there was a diffuse formation of tubercle. The tubules and tissue of the epididymis was replaced by tubercle granula, composed in the periphery of round and spindle-shaped cells; arranged concentrically in the centre of each granulum was either beginning disintegration of the cells spheroidal or round, leaving nuclei or portions of detritus, or there was detritus and round cells. Giant-cells were found either in the centre or the periphery, generally the latter in numerous instances.

(*d*) In this portion of the organ the most interesting change was found in one or two spots. This consisted of a single tubule replaced by a tubercle granulum, while the surrounding tubes showed slight changes. In such a structure, the most external part, could be seen one or two strands of connective tissue, apparently the remains of the wall of the tube within these spheroidal cells, while deeper was a zone of epithelioid cells with giant-cells; in this zone the cells were beginning to undergo hyaline changes; in the centre was detritus and loose nuclei. A photograph of this change is given.

(*e*) In this organ I found no changes corresponding to those described by some authors, who show pictures of centres of tubes or tubules; the detritus and cells and nuclei conform to a structure resembling giant-cells.

(*f*) Obliterating changes were here also found in the smaller blood-vessels.

Tubercle bacilli were found, first in the testis, in the tubercle tissue, in granula, in the periphery of the same, and in the centre in giant-cells, and in the connective tissue, and round-cell infiltration between the areas of diffuse tubercle. They were not found at all or in very spare numbers in cheesy areas.

In the epididymis they were present in the tubercular areas, but especially in those of the tubes, which are described above as apparently just replaced by one tubercle granulum.

The structures of the spermatic cord at the point of incision were the seat of no change of distinctive character; there was an infiltration of small round cells very distinct between the structures of the cord. The vas deferens showed no change; the tissue, external to the same, showed an infiltration of round cells; but in children I would hesitate before calling this abnormal. No tubercle bacilli were found.

The small piece of tissue excised from the return of the disease *in loco* showed that what had appeared as small yellowish granules on the skin surface were tubercle granula of recent formation; they appeared in the very superficial layers of the skin, replacing the same even to the epithelium surface. They were composed of round cells, or spheroidal cells; at the centre they were beginning to disintegrate. Below these tubercle granula the smaller arteries showed obliterating changes of a tubercular character with hyaline degeneration of their walls. But especially interesting was a very recent eruption of miliary tubercles found in the deeper layers of subcutaneous connective tissue, which was excised also at the time with the above.

Tubercle bacilli were present in these growths in very large numbers in the tubercle granula, in the infiltrated adjacent tissue in the walls of the affected blood-vessels, and in portions of tissue apparently not yet invaded by disease.

Before going into detail, it is important to establish the fact that what many authors have called abscess in these tuberculous testes is not, as we know, abscess in the true sense, unless there has been a mixed infection. If such a softened area is cut into, the creamy yellowish fluid will be found to be devoid of any of the characters except its color of pus. It is made up of detritus, few nuclei, and we will be fortunate if we can establish bacilli, for in some of these cases the bacilli are not apt to respond to our tests.

In our case the tubercular process manifests itself by (*a*) diffuse formation of tubercle; (*b*) recent miliary tubercles; (*c*) interstitial changes accompanying the same; (*d*) changes in the blood-vessels. In the epididymis we had found old and recent tubercle, (*a*) peculiar changes in the tubes, both in the walls and epithelium; (*b*) interstitial changes, and finally changes in the blood-vessels.

In advanced processes, as was the case in our patient, it can scarcely be possible to state with certainty whether the testis or epididymis was primarily affected, the testis being in my case the seat of the greatest change, showing less recent formations than the epididymis.

Differential diagnosis.—In the diagnosis of this form of disease of the testis, I will only point out the importance of distinguishing between tuberculosis and syphilis. In the latter case, the disease is completely under the control of internal medication. Fournier, whose experience in this field seems to have been quite large, describes the form of testicular tumor in hereditary syphilis as identical with that of acquired syphilis. In his cases he has found this so. There is tumefaction with preservation of the ovoid form of the testis. This form is always retained. There may be general induration, or, more generally, partial sclerosis in areas. These plaques of hardness, or sclerosis, feeling as they do like grains of lead or dried peas, have been called nodules of Ricord. The vas deferens, seminal vesicles, and prostate remain intact. The termination of the malady, if left to nature, is a sclero-atrophy of the organ. I have carefully brought these notes of Fournier forward because, whenever a case of testicular trouble is presented, syphilis in the minds of some is the first and most natural diagnosis.

In none of Fournier's cases did breaking down or the so-called abscess or sinus result. It must therefore be exceptional. Then he lays stress upon the preservation of the ovoid (smooth) form of the original organ. Such a case I have had lately, in which a uniform ivory-like sclerosis of the left testis occurred, with slight enlargement and marked increase, also, in weight of the organ, in a child twelve months old, whom I had at a very early period treated for an eruption, which was diagnosticated as a papular syphilide. This testicular tumor became smaller, but retained its sclerotic consistence under specific treatment. In all the cases of tubercular testis thus far recorded in children there has been involvement of the skin, breaking down into what the authors have called abscess (?), and discharge externally, or, if this had not already existed, it was threatening. Then the tendency in some reported cases to involve the prostate and other structures, as the cord and vas deferens. An enlarged, irregular, nodular organ with discharging sinuses, enlarged cord, should make us think of tuberculosis.

In looking over the twelve cases which I have collected in this paper from the literature, we find that tuberculosis of the testis has been described as occurring in infants from the second month to three years and nine months. The disease in some cases is mentioned as having been noticed immediately after birth. The right testis seems to have been the selected organ in the majority of cases. In most cases the tuberculosis of the testis or epididymis apparently was primary, and the first manifestation of the disease; in some cases it was followed by general infection; in others, there are no data as to this termination. In one case an isolated cerebral tubercular mass was found to have caused death, apparently having been formed after the clinical diagnosis of tubercular testis had been established. In four cases the spermatic cord was affected with the testis, and in one case the disease had spread to the prostate and seminal vesicles. It is to be especially noted that in no case could a traumatism be clearly established, and that most cases, especially those recorded by Lammelongue's studies, in Verneuil, had an hereditary history. The father, in most cases, was the victim of phthisis. In my own case this undoubtedly was the fact. The fact of this isolated occurrence of a tubercular organ, at a very tender age, as the first symptom of a tubercular infection, with an hereditary history, lends additional support to the theory of the intrauterine origin of most of these cases, the heredity of tuberculosis, the congenital tuberculosis in Baumgarten's sense.

It is not the pretence of this paper to attempt so ambitious a theme as the exact treatment of these cases in the face of such paucity of material; but certain it is that the operative indication appears to interfere very early in all these cases. Even where it is not possible to establish the presence of tubercle bacilli from the scrapings of a sinus, the patient is better protected by an early removal of the disease, for in many tubercular testis, for some unknown reason, it is not possible to establish the presence of these micro-organisms.

Delay through ineffective medicinal treatment does injustice to the little patients, for it seems that at the outset the disease is certainly purely local. If operation be resorted to, it should be thorough, for even in our case a distinguished operator was baffled by a return *in loco*, and I wish to point out that the local return occurred not only in the cicatrix, but, deep in the connective tissue of the scrotum, in the very midst of what to the naked eye was to all intents healthy tissue, a fresh eruption of miliary tubercle was found, and tubercle bacilli were found in the lymph spaces of the connective tissue.

In conclusion I desire to express my very sincere thanks to Professor Weir, of New York, and Dr. W. W. Van Arsdale, of New York, for the many courtesies in connection with the recorded case.

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SCLEREMA NEONATORUM—REPORT OF A CASE.

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I HAVE to present to you a typical case of sclerema neonatorum, a disease which is rare in America, occurs seldom in England, and is by no means common in France and Germany. At the New York Foundling Asylum, where have been received seven thousand foundlings in the seven years of my connection with that institution, there has been but this one case. It is rather a medical curiosity, not, however, without interest and importance in diagnosis, although rather hopeless in prognosis and unsatisfactory in treatment. It does not meet the practitioner in his home-practice, but finds its way into foundling asylums from damp subcellars, and from the corners of debauchery and squalor in a great city.

The present case is so typical of its kind, and so fully described in medical literature, that I shall take your time for little more than its simple narration.

In February, 1885, there were brought to the asylum, by an unknown person, a pair of twins, five days old. Both were girls, weighing about seven pounds each, though one was weaker, jaundiced, affected with sprue, and registered a temperature, on an approved thermometer, five minutes in the rectum, of $96\frac{1}{2}°$ Fahr.

The stronger child had nothing about it to attract further attention, and was accordingly transferred to the nurseries. She died the following July (aged six months), with a diagnosis of cholera infantum.

The child with whom we have to do was given in charge of a nurse, with instructions to try and restore its bodily temperature. All efforts at restoration, however, failed utterly, and to the nurses of the hospital the patient is still known and remembered as the "cold baby" or the "stone baby."

On the seventh day of its life I saw the child with Dr. Henry Blodgett, the resident physician, who believed it to be similar to a case he had seen during his studies on the continent of Europe, and he had already made a diagnosis of sclerema. What had been described as puffiness of the feet, on entrance, was now hardness, giving to the finger-pressure a sensation of half-frozen tissue. This condition had spread up the legs, was upon the thighs and hips, shoulders, arms and hands, scalp and face; was least marked on the abdomen, most marked on the thighs and arms, was distinct and characteristic on the cheeks. The face was rigid, cold, and mask-like, the thighs and shoulders immovable, the elbows and knees stiff.

One seeing, for the first time, this infant as it appeared on that day, would be struck with its dirty brownish-yellow color, with its smooth, prominent cheeks and chin, its unchanging and constrained posture; and if he were, with blindfolded eyes, to manipulate it, or even put his finger into its mouth, would be struck with its coldness. As for its general feeling, it would be best likened, from its hardness and frigidity, to a half-frozen cadaver.

It emitted a small squeaking cry while being handled, moaning occasionally, but otherwise remained quiet, with closed eyes. Its pulse was not perceptible at the wrist; respiration was shallow and quiet; temperature descending. The mercury of a thermometer, in the rectum five minutes, did not rise to the lowest figures of the register. In this condition it lay and cooled and hardened till the ninth day after birth, when it was pronounced dead.

At autopsy, the distribution of subcutaneous hardening was the same as during life, the abdominal wall being least affected. The tissues behaved under the knife like half-frozen fat, hardest and most resisting over the buttocks, thighs, and cheeks. On section of these parts there was no escape of fluid,—serum or blood; the cut was dry, as though dividing half-frozen tissue; no œdema. The skull was normal, its anterior fontanel measuring about a centimetre across its lateral angles. The brain was normal.

In the lungs were scattered dark hemorrhagic masses, distributed beneath the pleura of the anterior and lateral surfaces and base and throughout the organ. The lungs had been fully aërated and were nowhere collapsed.

The heart and great vessels were normal; foramen ovale and ductus arteriosus closed. The pulmonary artery and aorta were believed to be in proper proportions of size to each other and to the heart's cavities; the partitions, chambers, and muscles of the latter being, severally, of normal weight, size, and quality of tissue.

Kidneys.—Urates were collected in the tubuli uriniferi, showing fine red diverging lines upon the congested pyramids. The tissues of the organ were normal. Stomach and intestines were normal. Liver was normal, as was the umbilical vein.

Microscopical examination of the liver showed a moderate degree of congestion; otherwise it was normal; kidneys also normal.

The dark masses in the lungs were composed of fresh blood-cells in the alveoli, connective tissue, and lymph-spaces. There were no swollen epithelia, and no evidence of bronchitis or foreign bodies.

Examination of the skin and subcutaneous tissue was made from specimens selected from the following locations,—viz., abdomen, anterior aspect of thigh, calf, dorsal and plantar, surfaces of the foot.

One leg was removed at the hip-joint, and the vessels injected with gelatin blue, as recommended by some writers, to test the permeability of the cutaneous capillaries. For control examinations, specimens were removed from the same locations in two other infants of similar age. These selected specimens were hardened in different approved fluids.

The capillaries took the blue injection well, showing so excellently the vascular net-work that the specimen was thought worthy to serve for class instruction in normal histology. In the uninjected specimens no vessels were observed to be abnormal. The connective-tissue bands and adipose tissue could not be pronounced in any way unlike the type of the two normal control specimens, neither was there any abnormity to be detected in the lymphatics. In short, a morphological examination disclosed no lesion and suggested no cause for the condition found in the subcutaneous tissue before death.

I may state that my own examination of these specimens has been supplemented with partial examinations by expert general pathologists and by skin specialists, and the report as given above is in conformity with their opinions.

I have recited the case of a feeble twin, born in midwinter, in squalor, which developed progressive and extended subcutaneous hardening, coincident with a gradual and excessive depression of the body temperature, ending in death on the ninth day.

A morphological study of the tissues has given but negative results.

I shall not take your time to give what can be found in every French and German cyclopædia of medicine.* Suffice it to say, I have recited a case which is typical as there described.

The Surgeon-General's office has kindly furnished me references to five American cases. Only one of these closely approaches the type seen in the large foundling houses of

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* "Sclérème du Nouveau-Né," "Nouveau Dictionnaire de Médecine et de Chirurgie Pratiques," vol. xxxii. p. 603; "Sklerema Neonatorum," "Real-Encyclopädie der Gesammten Heilkunde," 1889, xviii. 341.

France and Germany, and that is a case reported by Dr. Ellen A. Ingersoll, of Canton, Ill.*

One case referred to was forty-five years old.† In one the hardening was local, lasted six months, and the patient was still living when the case was reported.‡ Another was reported as improving from what seemed a case of sclerema.§ Another after four to five weeks recovered.||

The cases from which it is necessary to diagnosticate sclerema of the new-born are those of œdema.

It cannot be too plainly stated that sclerema, outside of foundling asylums and the most squalid districts of the large cities, is very rare in this country. No doubt the report now presented will bring to light cases which answer the descriptions here rehearsed; but let it be remembered *œdema* of the new-born, also, conforms, in part, to the main features of the description. In *œdema* there is a lowering of the body temperature, and the œdematous regions may become firm, but neither of these symptoms reach the degree to which they attain in sclerema.

As an illustration, I may say I have held the above recorded case four and a half years, expecting to find another to study in connection with it. In that time many babies have been shown to me, both hardened and cold, but, when examined, these features have not corresponded in degree, at all, to the case which did not raise the mercury to the lowest record figure. So I beg you be on your guard; see if the œdema pits, under finger-pressure, are symmetrical, confined to the lower extremities or to the dependent portions of the body. There is a feeling of immobility about sclerematous tissues, as

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* Ellen A. Ingersoll, "Sclerema Neonatorum," *Peoria Med. Month.*, 1887–88, viii. 240.

† H. C. Gardinier, "A Case of Sclerodactyle with Diffuse Scleroderma," *Am. Jour. Med. Sci.*, Phila., 1889, n. s., xcvii. 15–25.

‡ C. D. Smith, "A Case of Sclerema or Induration of the Cellular Tissues of an Infant, with Remarks" (read before the Society of Medical Inquiry), *N. Y. Jour. Med.*, 1854, xii. n. s., 190–194.

§ A. R. Robinson, "Sclerema Neonatorum," Case, *Arch. Dermat.*, New York, 1882, viii. 337.

|| C. C. McDowell, "Case of Scleroderma occurring in a Patient Three Weeks of Age," *Maryland Medical Journal*, Baltimore, 1877, 1–203.

though they were a compact mass, the skin not moving on the muscles, and not to be gathered up into rolls. Sclerema begins in the lower extremities mostly, but it later selects the regions of accumulated fat, and shows peculiarly this tendency when the cheeks are involved.

In the case given by Dr. Ingersoll the labor was normal, the child weighing seven or eight pounds. On the third day sclerema appeared, involving the scrotum and anterior surface of the thigh. It then passed to the neck, chest, and superior extremities, and death occurred in forty-eight hours from interference with respiration. The muscles of respiration and of deglutition were supposed to be sclerosed. The mother was thirty-five years of age, and this was her eighth pregnancy. She had been in liquor for several days prior to confinement, and was much exposed in midwinter.

If I were to present a composite picture of cases of true sclerema neonatorum, it would have the prominent points of the case I have here presented.

In regard to the pathology of this affection, I find that almost everything has been touched upon.

Each observer who has written on sclerema has given some explanation founded upon this individual study. One has found fatty heart, one faulty innervation of the heart; several have found it associated with, and probably due to, imperfect expansion of the lungs and defective hæmatosis; several have attributed it to obstruction of the cutaneous capillaries and lymphatics and suppression of the sweat functions, etc. Parrot,* to whom all subsequent writers refer with great satisfaction, found all the elements of the skin changed, some increased, some diminished, and always in infants who were in the last stage of an obstinate intestinal disease.

The most satisfactory explanation for the hardening of the subcutaneous tissue in sclerema (skin-bound) of the new-born

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* J. Parrot, "Endurcissement L'Athrepsie," Clinique des Nouveau-Nés, Paris, 1877, pp. 116, 118, 121; "Œdème," p. 205; C. Henry, "Verhärtung des Zellgewebes," *Handbuch der Kinderheilkunde*, Bd. ii. 1871, pp. 40–158; Meigs and Pepper, "Sclerema," "Diseases of Children," Phila., 1883, p. 976; Eustace Smith, "Sclerema," "Diseases of Children," New York, 1886.

is based on the statement of Langer,* that children's fat contains much more palmatin and stearin than that of adults, and solidifies upon moderate depression of temperature.

DISCUSSION.

Dr. Huber.—I have in mind a child, the subject of congenital syphilis, who died at the age of a few months, presenting the appearance described. It presented all the physical characters of sclerema, although several months old. The tissues did not seem to be hypertrophied, but were very hard.

Dr. Koplik.—This is very common in the foundling asylums of Europe. In Prague, Epstein has shown me cases of this condition. He does not regard it as a disease, but as a symptom preceding death. I have seen cases in midsummer as well as in winter. Many of these cases seem to be very atrophic infants, the subjects of congenital syphilis. I did not know that these cases were considered rare on this side of the water. In my own dispensary I have seen them.

Dr. Holt.—An unusual case had come under my observation, which, although it differed in some respects very much from the classical picture of sclerema, seemed certainly to belong to the same class of cases.

The infant came under observation when thirteen days old, and had a large cephalo-hæmatoma. On the shoulders, back, arms, neck, and in the cheeks were areas resembling sclerema, covering almost the whole surface; they were separated by small fissures; they were hard and board-like, cool, and did not pit on pressure. There were no areas on the abdomen, chest in front, forearms, or lower extremities.

The child was well nourished, and the rectal temperature at no time subnormal.

The scleremic patches slowly disappeared without treatment, and at the end of five months were to be felt on the shoulders only.

Sclerema neonatorum he thought to be an exceedingly rare disease in this country. This was the only case bearing any resemblance to it which he had seen here.

The President.—I am convinced of the rarity of sclerema. I have not seen a case in twenty-five years. I have seen but two cases of the affection. At this time the etiology was believed to be that of ordinary œdema. But that cannot be the case. The parts are very hard and do not pit upon pressure.

What has been said in regard to the chemistry of the fats is

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* Ludwig Langer, *Wiener Sitzungsbericht*, 1881.

certainly more suggestive. The fat of the newly-born child is quite different from that of the adult. In the adult the chief constituent is oleic acid, while palmitin and stearin form only a small part, about nine per cent. The fat of the new-born contains four times as much palmitic acid and twice as much stearic acid as that of the adult. Both of them melt at a higher temperature than the former. Thus it would appear that they harden when the temperature of the body sinks much below the normal, as it will in sclerema.

Dr. Northrup.—Since I found this case, in 1885, I have been looking for another, but have not yet met with it. My attention has frequently been called to supposed cases, but the appearance did not correspond. I think that there is some misunderstanding as to what constitutes sclerema. The typical picture makes it a rare and fatal condition. The cases of recovery which have been reported have been localized.

TWO FATAL CASES OF BILIARY CIRRHOSIS (CONGENITAL PERNICIOUS ICTERUS) IN THE SAME FAMILY.

REPORTED BY MARCUS P. HATFIELD, M.D.,
Chicago.

Case I.—Mrs. St. J., aged forty, VIIpara, was confined on the night of August 22, 1889. Her attending physician, Dr. J. R. Kewley, of this city, informs me that the labor was normal, with the exception of a mild post-partum hemorrhage and too copious flowing for the first three days of her lying in. The child, a boy of seven and seven-eighths pounds, was well nourished, but almost immediately vomited freely a frothy, greenish-yellow liquid, which was so copious as to gush from the nostrils and trickle into the larynx, producing severe coughing. The infant was liberally covered with sebaceous material, stained a greenish yellow from the amniotic fluid, which had been present in large quantity and was of the same yellow color. The skin at first presented but little, if any, evidence of jaundice, but it speedily became icteric, reaching its maximum discoloration upon the fourth day. At this time, when first seen by the writer, the child's sclerotics, secretions, and entire cuticle were of an intense lemon-yellow hue, so brilliant that it was difficult to conceive how a living human being could become thus pigmented; even the mucous membranes and the secretions of the mouth and nose sharing in the jaundice. Assimilation from the first was defective. After the second day, until within a few hours of its death, the babe was unable to nurse, and was nourished entirely on small quantities of breast-milk administered with a spoon; but even this it was unable to digest, although the mother's milk appeared perfectly normal. At irregular intervals there was vomiting of yellowish or greenish mucus, etc. At times the child was quiet and slept well; at others, fretful and crying; during the first week (even in sleep) twitching of hands, etc., would occur. The urine was rather scanty and deeply stained the napkins, and for the first few days red and yellow lithates were freely deposited upon the diaper. The stools, after the ordinary amount of meconium had passed, presented the yellowish staining of bile more or less mixed with green, and at all times showed undigested milk-curd. From the second day hemorrhagic petechiæ were present on the face and trunk, but at no time could suppuration be found around the umbilicus. The cord was not separated at death (thirteenth day); but on September 1 (ninth day) there was a slight detachment with very free hemorrhage and previous occasional oozing of blood, readily controlled by hot water and a compress. At this time (ninth day) about a quarter inch of desiccated cord was removed, the remaining part found moist, looking something like a slough, and taking on a putrid odor from the time of the first hemorrhage. Death was painless, the child becoming very quiet for a few hours preceding death, the respirations becoming shallower and more infrequent, until it finally ended its life with a final flickering gasp of exhaustion.

An *autopsy* was held upon the child, a few hours after its death, by Drs. Kewley and Hatfield. The body was found, as might be expected, quite emaciated and still tinged yellow, but with more of a greenish tinge than when first seen,—a change which was noticed to have been taking place for three or four days before death. Lanugo was profuse, and the skin leathery to touch, in tint and feel closely resembling the druggists' so-called chamois skin. The umbilical cord, although it was the thirteenth day, had not properly come away, but had left a dry, fetid stump behind, which protruded from the umbilical ring. No evidence of umbilical suppuration; neither was there any evidence of umbilical arteritis or phlebitis. The subcutaneous fat was yellower than normal and the peritoneal fluid as yellow as bile. The stomach was not opened, as it and the intestines were flaccid and almost empty. The lacteals showed no evidence of disease, nor did the bladder, which was fully distended with saffron-colored urine. The heart was normal, lungs the same, except that they were tinged yellow at their margins. The right pleural cavity was about half filled with a bloody fluid, none of which was saved for examination; nor were the kidneys examined, as the writer now regrets. The spleen—brick red and very friable—was with the liver removed for examination by Dr. Elbert Wing, the pathologist of Chicago Medical College, whose report is herewith given.

"*Gross appearance of liver.*—5 x $2\frac{3}{4}$ x $1\frac{5}{8}$ inches, dark blackish brown, surface uniform in color, capsule unchanged; firmness under palpation normal; cut surface same color as serous surface, with an added superficial tinge of greenish yellow flecked with very minute whitish specks and streaks, which suggest possible cirrhosis; not much blood in branches of vena cava, their surface greenish yellow, but not stained; cut surface quite moist and apparently somewhat softened.

"*Spleen.*—Small petechial spots scattered through the organ. Fragment only furnished. Apparently much enlarged; dark red in appearance, very soft; cut surface deep red color, soft, moist; Malpighian bodies hardly distinguishable, trabeculæ not distinguishable.

"*Lung.*—Only small pieces furnished. Greenish-yellow tinge over all; areas of red blotches; vessels not visible; blood only partially to be washed out; floats, but not freely; consolidation not certain; firm and elastic to touch.

"*Pancreas.*—Organ somewhat firmer than normal on palpation; same greenish-yellow tinge over and throughout the organ.

"*Microscopical appearance of liver.*—1. There is a large number of circumscribed, circular, and ovoid, occasionally branching, islands of connective tissue, which surround the gall-ducts. An occasional aggregation of leucocytes lie in the periphery of the lobules, but in no case surround them.

"2. The capillaries are apparently thicker than normal, and in large areas of the tissue are irregular in size, contour, and distribution; they contain a few leucocytes.

"3. In many places the amount of connective tissue, which represents the reflections of the capsule of Glisson, is largely in excess of normal.

"4. Scattered over the sections, in much the same general manner as the islands of leucocytes are distributed in chronic syphilitic hepatitis, there are clumps of small, round, solid nuclei, whose arrangement is that of those surrounding a gall-duct in some cases, and in others so strongly suggests the same arrangement that there can be little doubt that they are such.

"5. The petechial spots, mentioned in the description of the gross appearances, cannot be seen in the stained and cleared section.

"6. The capsule is moderately thickened.

"7. The greenish-yellow stain, mentioned in the description of the microscopic appearance, is due to (*a*) a granular pigment, which is distributed irregularly in the lobules, but which, taken in relatively large areas, is considerably more abundant in some parts of the sections than in others; (*b*) a greenish-yellow stain which lenses of a power of three hundred and twenty-five diameters does not resolve into granular matter.

"8. The central veins of the lobules cannot be clearly made out.

"*Lung tissue.*—1. There is a small number of areas in which the alveoli are filled with epithelial cells and leucocytes. These areas vary in size, but are all small.

"2. The connective tissue which surrounds the arteries is in most cross-sections increased in amount, and in some markedly so.

"3. Throughout the sections there are areas of hemorrhagic extravasation. Some of these are quite large and are evidently the petechial spots mentioned in the description of the gross appearances of the tissue.

"4. The pleura is apparently thickened, and there are long, slender processes of connective tissue which extend from it down into the tissue of the lung."

Conclusions.—The hepatic lesions are those of biliary cirrhosis, or that in which the hepatic cells undergo destructive changes, and connective tissue fills the gap. In this variety of cirrhosis the newly-formed connective tissue shows little tendency to shrink, and hence the French authors have given it the name of *cirrhose hypertrophie avec ictere.* The disease, as manifested in adults, is one of slow duration, usually of one or two years, and the prognosis fatal. Where obstruction of the common duct cannot be demonstrated, the disease must be regarded as primary. The lung lesions are analogous to those found in the liver.

Case II. was the sixth child of the same mother. Neither of the physicians in attendance upon the seventh confinement were with her at that time, but the mother, who is a more than usually intelligent woman, gives an account of this child, which is almost an exact counterpart of the one just detailed. The child was apparently well nourished and healthy, but soon developed intense jaundice, and died on the thirteenth day, probably in a slight convulsion. No post-mortem was made upon the first, but there is every reason to believe that the two cases were identical, and that both were well-marked cases of biliary cirrhosis. This is usually supposed to be a disease of later life, for, so far as the writer is informed, there is no account of its characteristic lesions being found in so young a child. There can, however, be no doubt in this case. The microscopic slides were exquisite, showing beyond a doubt the characteristic, circumscribed, cirrhotic areas and loculi left by the destruction of the liver-cells. This lesion Strümpel claims is due to the destructive effect of retained bile in the liver, and differs in every way from ordinary cirrhosis of that organ. The conviction, however, forces itself upon the writer that the etiology of these cases must be found somewhere in the prenatal life of the child. Bile was secreted to excess before birth, as proved by the color of the smegma and the bright yellow amniotic fluid at birth.

The fact that the preceding child, under the care of a different nurse and other physicians, died in exactly the same way strongly militates against icterus due to like bacterial infection. If due to infection, it must have been in both cases autogenetic rather than suppurative or puerperal. The mother at both times, it must be remembered, had a satisfactory childbed, with the exception of post-partum hemorrhage; in the latter case without an unfavorable symptom. We must, therefore, look to the child itself rather than its postnatal surroundings for the cause of its death. The cause must have been congenital, for its effects were manifested in a few hours after birth. Furthermore, from the steady progress of the case to a fatal termination, we may infer that the cause of this pernicious jaundice was organic rather than functional, and we might anticipate finding this cause either in the liver or the spleen, possibly in both. Dr. Wing's report inclines us to the belief that the liver was primarily at fault, and that the lesion was of the nature of circumscribed or biliary cirrhosis.

No syphilitic or constitutional taint was found upon either side of the family. The mother's vigor was but slightly, if any, impaired from her frequent childbirths and hard work. She now suffers only from perineal rupture and internal hemorrhoids, which at times bleed freely. The father has at times suffered from severe sciatica of right leg, accompanied by small abscesses. These attacks recurred with increasing frequency of late years, and are traced back to an injury of the hip from the explosion of a full cartridge-box during an engagement in our late war. The fragment of shell propelled by the explosion produced a very severe contusion, but no wound. Aside from the above, which at times confines him to the house for one to three weeks, he is in good health.

CARPO-PEDAL CONTRACTIONS—ONE MANIFESTATION OF TETANY.

BY CHARLES WARRINGTON EARLE, M.D.,

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THE exhaustive articles by Professor J. Lewis Smith, published in the ARCHIVES OF PEDIATRICS during the past three or four months, make it entirely unnecessary for me to add a single word on this subject. But inasmuch as my first case was recorded in 1882, and at that time in all pediatrical literature at my command it was only mentioned incidentally, and in systematic works on diseases of children at this time the subject of tetany as distinct from tetanus is not fully brought out, it may be profitable for us to very briefly consider it.

In March, 1882, I was called to see Lillian Walker, aged two and a half years, whom I found well nourished, but, from a slight indigestion, suffering with a troublesome diarrhœa. A day or two previous she had complained of pain in her feet and lower limbs, and had experienced a slight difficulty in deglutition. There was some little evidence that she had swallowed a small button, and she was, moreover, unduly nervous. The following day she ate very heartily of fried potatoes, and a short time following this it was noticed that her hands and feet were in a peculiar position and painful to the touch. During the day the hands became flexed and the feet extended, and both hands and feet—particularly the latter—considerably swollen. The muscles in the posterior part of the leg were also involved. The child frequently cried out in pain, but the pulse and temperature were normal, and there was very little, if any, constitutional disturbance. She was ordered a laxative, to be followed with a proper dose of bromide of potassium in combination with a small amount of chloral hydrate and tincture of Calabar bean. The feet and hands were ordered to be enveloped in hot cloths and moderate counter-irritation (mustard) to the spine. In five days the child was well, and, as far as I am informed, has never had a recurrence of the difficulty since.

CASE II.—Baby Arnold, aged six months. She was teething; had a very decided tendency to skin eruptions of various kinds, and was bottle-fed. Had painful contractures of hands and feet, which were at the same time considerably swollen. There were no constitutional symptoms of any moment, although the temperature was 99½° some portions of the time. In ten days all pain, swelling, and deformity had disappeared, and the child was as well as usual. I should add that about one month subsequent to this, after an illness of only one or two days, the child died from cholera infantum.

My first case was a strong, robust, and well-nourished child, and the recovery was complete. The second case was a child whose nourishment never satisfied me, although the parents devoted themselves assiduously to its care. It was always having some skin difficulty, and never had a ruddy, healthy appearance.

The first clear descriptions of this disease were given between 1830 and 1835 by French physicians who were engaged in studying particularly this difficulty at that time. The most exhaustive article previous to those by Professor Smith, in the English language, is by Erb, vol. xi., Ziemssen. A more careful search, however, has revealed the fact that long before the French described it, even as early as 1815 and 1817, carpo-pedal contractures were described in English literature. In Eberlee's "Practice" (1831) and in John Clark's "Commentaries," about this time, in vol. xii. *Edinburgh Medical Journal*, allusions are made, and in the *Medico-Chirurgical Journal* (vol. iii., 1817) Dr. James Johnson uses the words "carpo-pedal spasm."

The word *tetany* was introduced by Dr. Lucien Corvisart in 1851, and has been very generally adopted, although the exact differentiation between the terms *tetany* and *tetanus* is not, to my mind, very clear. Carpo-pedal contractions as a name is not enough. Contractions in the feet and hands were the principal symptoms in my cases, but in others many different muscles may be the point of attack. The muscles of the head and back and abdomen are sometimes involved, and rarely those of the face, tongue, and those of mastication. The malady becomes dangerous to life as the diaphragm becomes the point of spasm.

Causes.—It is conceded by all authorities that it is among children that we find this condition existing with greatest frequency, although people of all ages may become its victims. Pregnancy and the puerperal state seem to be predisposed to it, and certain occupations exercise some influence in its production. Disturbances in the alimentary canal, such as indigestions and exhausting diarrhœas and intestinal worms, cause it. Constipation in some cases seems to be a cause. To these etiological factors the old authors add dentition. Professor J. Lewis Smith narrates a case in which the contractions continued for three weeks, which quickly abated when several imprisoned teeth escaped. Exposure to cold and those causes which seem to produce in certain people the development of rheumatism are mentioned as exciting causes of this disease. Tetany also takes place after certain prostrating diseases, and it is possible that an inherited nervous condition may predispose to it. Professor Smith observed it so frequently in the early part of 1889 that the term epidemic could very properly be applied to it. The influence of reflex irritation as a cause of this difficulty has been closely studied by Romberg, who confesses his inability to make positive assertions, but who believes it demonstrated by both experiment and clinical observation.

Herz (in *Jahrbuch für Kinderheilkunde*, xviii. 2) says that clinical phenomena indicate that the disease is due to anæmia of the cord.

Symptoms.—In a child these must be mainly, if not wholly, objective; in adults premonitory symptoms are noticed in some cases. The peculiar shape of the feet and hands, their rigidity and pain, which is experienced on pressure, are the most marked symptoms. In the cases under my observation the hands have been flexed and the feet extended. The feet, particularly the upper parts, have been swollen. The spasm has been constant, not intermittent, as noticed by some writers.

While the exciting cause (in the cases under my observation always in the digestive tract) is present, there is some fever with its usual accompaniments, which disappear usually a short time after the evacuation of the bowels. There has been slight nervousness, but nothing like a general convulsion. The contractions have always been bilateral, and have been in both upper and lower extremities. It has not been my fortune to see cases of such severity as to have spasm of the abdominal or thoracic muscles, and no embarrassment in respiration has taken place, —all these symptoms are recorded by some observers.

The electrical behavior of muscles in this disease has been noticed by Benedict and Kussmaul, and consists mainly in an increased excitability excepting in the branches of the facial nerve. What is known as Trousseau's symptom is, that if the larger arterial and nerve-trunks of the contracted muscles are compressed the contraction is increased. As to the reliability of this symptom I cannot speak from experience.

The duration of tetany is from a day or two to several weeks or months, and there seems to be a tendency in some subjects to a recurrence.

The prognosis is favorable, particularly in children. In fatal cases there is usually some pre-existing disease or some serious complication not due to tetany.

The diagnosis will be made by the peculiar grouping of symptoms, the characteristic positions of the extremities, the bilateral tendencies, and the absence of cerebral and general disturbances. Tetanus of the new-born generally takes place within a few days after birth; tetany, not till the time for gastro-intestinal disorders is reached. The muscles of mastication are involved early in tetanus; those in the extremities early in tetany; and those of mastication, in all probability, not at all. In tetanus all the symptoms rapidly tend to become more and more serious; in tetany the history is towards recovery.

Treatment.—Remove the cause, particularly if it arises from the retention of undigested food. Envelop the limbs in hot cloths, and administer full doses of the bromide of potassium. To this remedy, which in most cases is all that is needed, may be added chloral hydrate, and from its effect in other similar diseases the Calabar bean seems to be indicated.

PROLAPSUS RECTI DUE TO LARGE STONE IN THE BLADDER OF A CHILD THREE AND A HALF YEARS OLD: REMOVAL: CURE.

BY A. CAILLÉ, M.D.,

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MARY X., three and a half years old, came under my notice as a dispensary patient in November, 1888, with the following history, as furnished by the mother: About one year before presentation the child's gut was found prolapsed after each stool, and she appeared to be in great pain in passing her urine. She was taken to a number of physicians and dispensaries for treatment, and presented at almost all the clinics as a case of inveterate and severe prolapsus recti, and many methods of treatment were tried without affording the child the slightest relief or improvement. At my first examination I found the child to be anæmic, nervous, and cachectic in appearance, and suffering from diarrhœa and bronchitis. The rectum was prolapsed two inches, and during the examination it came down fully seven inches, and presented a slightly bleeding surface. A straining effort on the part of the child forced urine from the bladder, which was collected, and found to contain pus and much epithelium, as evidence of cystitis.

The sphincter ani was relaxed to such an extent that three fingers could be passed through it without an effort. The child was then anæsthetized, and a more careful examination showed the presence of a large stone, free, in the cavity of the bladder.

Speedy removal of the stone was suggested, and the suprapubic operation decided upon, on account of the large size of the stone and the facility of access by this operation.

The bladder was first thoroughly irrigated with a warm solution of boro-salicylic acid, and, after division of the skin in the linea alba, the patient was put in Trendelenburg's position, with head low and raised pelvis, by which means it was comparatively easy to avoid the reflection of the peritoneum.

It was not found necessary to raise the bladder by inflating the rectum,—two fingers of an assistant passed into the rectum being sufficient to bring bladder and stone into a convenient position above the symphysis. The bladder was now incised and the large stone removed with some difficulty, thereby producing slight laceration of the margin of the incised bladder.

Owing to this slight and unavoidable laceration primary union was not contemplated, but the bladder was sutured, nevertheless, and the wound filled with loose iodoform gauze, and the usual antiseptic dressing applied. The temperature of the patient was normal throughout the entire healing process, except on the third day after operation, when it rose to 102° F. for a few hours. The process of healing was all that could be desired, excepting a small leak in the suture, which was detected on the fourth day. At the end of three weeks the wound had closed, and the child was discharged cured.

During the time of convalescence the rectum came down once, and not again afterwards. The stone—which I here show you—is twice as large as a pigeon's egg and weighs twenty grammes.

Its presence in the bladder of the child had evidently caused the rectum to prolapse as a direct consequence of frequent straining, and its removal permitted the parts to assume their normal and natural condition.

DISCUSSION.

Dr. Fruitnight.[1]—In a paper which I read one year ago on urinary concretion in children, I made the statement that persistent prolapse of the rectum was nearly always an indication of stone in the bladder, and should always suggest an examination of that viscus.

PRACTICAL POINTS IN THE DIAGNOSIS AND TREATMENT OF MALARIA IN CHILDREN.

BY HIRAM N. VINEBERG, M.D.,

New York.

THE vague expression, "a touch of malaria," is heard as often in the diagnosis of the diseases of children as it is in that of the diseases of adults. This diagnosis, which is at once popular and covers a multitude of physical sins in the lay mind, is resorted to by the physician, not so much from a desire to seek shelter under a mantle of ignorance, as it is because he is too lazy or too busy to examine the child thoroughly. In the present state of medical knowledge, in spite of recent strides, protection under a mantle of ignorance is not only excusable but at times unavoidable. We use the term "neurasthenia," and are glad to have it for a set or group of symptoms of the pathology or nature of which we are in utter ignorance; but with malaria, however, the case is entirely different. Here we have a distinct poison, definite pathological processes, and a set of symptoms which, although they may be variable, are, on the whole, tolerably uniform.

In my opinion, the vagueness in the diagnosis of malaria in early life has been, in a measure, propagated by the system of elevating a single symptom into pathognomonic value. One would diagnosticate the affection from a peculiar state of the tongue; another, from the color of the skin; and a third, from some peculiarity of an abdominal pain. It would, in my mind, be just as scientific to make the diagnosis of pneumonia from some peculiarity in the cough, without a thorough physical examination of the chest, as it would be to make the diagnosis of malaria without noting the condition of the spleen, because the patient presented a dark-brown tint of the skin, or had headache, or because the tongue was coated with a brownish-yellow fur. One often hears it said, "Well, what does it matter about a correct diagnosis of malaria? If you suspect it, you give quinine and settle the point." But it *does* matter to the patient's welfare, and it *ought* to matter to the physician's self-respect, whether he treats disease with the best knowledge that is within him or at random by firing "shot doses" of medicine at it. Then, a few doses of quinine does not always cure malaria, while it may cure an entirely different affection. But of the value of quinine as a therapeutic test, later on.

It is my intention, therefore, in this article, to bring under review the most prominent and reliable symptoms of malarial poisoning as observed in early life, discuss each symptom separately, and thereby endeavor to estimate its value in forming a diagnosis of that affection. Afterwards the different diseases which may be mistaken for malaria will be discussed and an effort made to indicate their points of differentiation.

I have nothing particularly new or startling to offer. My object is merely to emphasize a few well-established facts that seem in danger of being consigned to oblivion, and to present some practical points that I have had to learn for myself, and the mention of which I only found, afterwards, scattered through a literature which, although not extensive, is not easily accessible. My remarks are based upon a careful study of eighty cases of malaria, in early life, that came under my observation in dispensary and private practice during the past eighteen months, and on a close perusal of the literature to which I have referred.

The prominent symptoms and signs of acute malaria are chills, convulsions, fever, sweating, enlargement of the spleen, hæmatozoa in the blood.

Chills.—In children the chills, as a rule, do not set in so abruptly as in the adult. There is usually a prodromal stage of a few days' duration characterized by malaise, a tired feeling, and lack of energy. The child does not play and run about as usual, and suffers from loss of appetite. In very early life—that is, under two years—chills are said never to occur, but I have observed distinct chills in one patient nineteen months old, and in another two years old. Instead of a chill, the mother, if observant, will usually notice that of a sudden the child grows drowsy, frequently yawns, and stretches itself several times. The lips and finger-nails become blue, while the little hands feel cold to the touch. Frequently twitching of the eyelids will be observed, and this phenomenon may be a forerunner of a convulsive seizure. In older children chills occur as in the adult, although they are seldom so pronounced or of such long duration. Sometimes they are entirely absent. Some of my patients complained merely of a chilly sensation running down the spine; others, again, had never even complained of feeling cold. The period of the day at which the chills occur varies very considerably. In my cases the chills—in fully half the number—took place towards evening, between 2 and 8 o'clock P.M.; of Holt's one hundred and six cases, in thirty-five the chills occurred in the forenoon, and seventy-one in the evening; Bohn's statistics correspond to the foregoing. The chills in early life are irregular in their recurrence. The mother will often tell you that they began at first late in the afternoon, but that each subsequent attack occurred earlier, so that the latter ones have taken place in the morning, or the reverse may have been the case; they began in the forenoon and ended by recurring in the afternoon or evening. The most common type in children, according to some observers, is the quotidian. Of Bohn's four hundred and sixty-five cases, two hundred and forty-five were of this type.

Next in frequency is the tertian form, which comprised two-thirds of my cases. The difference in statistics by different authors depends upon the severity of the epidemic; the more severe exhibiting the quotidian, the less severe the tertian form. Other forms are rare.

Recurring chills are common to other diseases than malaria. They are witnessed in hectic fever, in ulcero-endocarditis, in pyæmia, and whenever suppuration is taking place in deep-seated parts. Hectic fever is most likely to be the attendant of some chronic process, such as phthisis of the lungs, which is not an uncommon disease in childhood. When we recall the fact that malarial chills may frequently occur in the evening, the period at which the chills of hectic fever usually recur, it may be readily conceived that an error could easily be committed, if too much dependence were placed upon this symptom alone. The chills attending pyæmia and suppuration of the deeper parts seldom exhibit the same periodicity as those of malaria, nor the same freedom from febrile disturbance in the intervals. Further, the chills of pyæmia are often characterized by the profuse sweating which immediately follows them rather than by an active development of the fever. In the early stages of pyæmia, however, it will not always be easy to tell whether the chills are of pyæmic or malarial origin, particularly if the patient has not recently undergone an operation or the source of the pus is not evident. I retain a vivid recollection of a case that I saw in the Montreal General Hospital during my student career. A boy, æt. five years, was taken ill with recurring rigors, followed by fever and sweating. At first a diagnosis of malaria was made; but later on, as metastatic abscesses were observed in various parts of the body, the diagnosis was changed to pyæmia; but no suppurating lesion, as the source of the disease, could be detected. The hope of finding this, even at the autopsy, was almost given up when that most careful and acute observer, Dr. Wm. Osler, then of Montreal, began dissecting out every bone of the body, and finally found a small periosteal abscess of the tibia near the malleolus, which had not given rise to pain, and was overlooked during life. Ulcero-endocarditis is fortunately a rare disease. It forms one of those hidden rocks in medicine which the most skilled and experienced pilot in diagnosis is likely to run against. It is seldom a primary disease in childhood, but is usually secondary to rheumatism, suppurative disease of the bones or joints, diphtheria, and the infectious diseases. A physical examination of the heart will frequently, but not always, detect an endocardial murmur.

Even in subacute gastritis I have more than once observed the recurrence of chills, exhibiting apparently a periodic type.

The following case in private practice offers a pregnant example: X., æt. fourteen years, of a mobile nervous temperament, was taken ill on June 6 with a chill, malaise, fever, and pain in various parts of the body, but most pronounced across the front of the chest. The tongue was coated and the bowels were loose. The rectal temperature registered 104° and the pulse was 120. A careful examination of the chest detected nothing abnormal. There was no enlargement of the spleen. On the following day he was quite free from fever and felt well, excepting that his appetite was poor and he was rather weak. On June 8—that is, two days later—he had another marked chill, and when I saw him, an hour afterwards, the rectal temperature was 103°; the pulse 96. I again made a careful examination, but with negative results, save that pressure over the epigastrium elicited pain. *The spleen was decidedly not enlarged.* I ordered the continuance of the light diet which had been neglected as soon as he felt better, and I purposely refrained from giving any medicines. On the day following the temperature was 100°, and in a couple of days the patient was restored to his usual health. He has been under my constant observation ever since then, and he has remained perfectly well.

There has been no recurrence of the chills nor any symptom pointing to paludism. Comment is unnecessary.

There is an affection not observed, however, as far as I know, in early life that presents all the characters of intermittent fever, and is not due to malarial poisoning. I mention it here for two reasons: first, to show how conditions other than paludism may produce a train of symptoms which cannot be distinguished from those produced by the malarial poison; and, second, because I have good reasons for believing that the affection is not generally known. I have reference to the "fièvre intermittente hépatique," first described by Charcot,* and admitted by all the leading authorities on diseases of the liver. Two forms are described: one occurring in patients with latent malaria, and the entrance of a gall-stone in the common bile-duct calls forth chills; and the other occurring in patients entirely free from any malarial taint.

Convulsions.—In children it is not uncommon to have a malarial chill replaced by a convulsion, which may be repeated as many as three, four, six, and even eight times within a few hours. In one of my patients, a little boy nineteen months old, who had distinct chills, these were replaced, on one occasion, by eight convulsions in the course of a couple of hours.

* "Leçons sur les Maladies du Foie et des Reins." Paris, 1877.

At one time the patient may have a chill or that which has already been described as taking the place of it; at another time it may have a distinct convulsion; or again, it may have a chill which in a short time passes into a general convulsive seizure. Still further, there may not be any chills at all, but only attacks of convulsions. It would extend this paper to an undue length if I were to discuss the various affections in childhood that may be attended with convulsions. But there is one disease in particular which renders its subjects extremely prone to this disturbance of the nervous system,—I mean rickets.

The close association between rickets and convulsions is generally well known; but that which is not so well known is that the milder forms are just as likely as the severer forms to render the little patient subject to eclampsia. What I understand by the milder form is when the disease manifests itself only by delayed or premature dentition, by some sweating about the head, a tendency to kick off the bed-covering, and prominence of the superficial veins of the forehead and temples. In addition to the foregoing, there may be constipation or diarrhœa alternating with constipation. The case that I presented at the New York Academy of Medicine, March 14, 1889,* may have been said to have belonged to this class, for the nervous disturbances were severe in the extreme.

The baby had suffered for six weeks with attacks of laryngismus stridulus and severe eclamptic attacks. For days the convulsions recurred as often as six times a day, some of which were extremely protracted, one lasting over two hours. But the child made a complete recovery by the treatment being directed to the rickets. In addition, bromide of potassium was given. Quinine or arsenic was not administered. What makes these cases so difficult to differentiate from malaria is the circumstance that the spleen may be considerably swollen, as it was in the case just referred to.

The febrile stage.—The fever is the most constant and prominent act in the three-act drama of acute malaria. Lieber-

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* *New York Medical Journal*, June 8, 1889.

meister* says, "The febrile access is distinguished from the fever attending most other diseases by its violence, on the one hand, and its rapid, evolution on the other." The fever attains its maximum rapidly, at which point it remains for some hours, but the descent of the temperature-curve is gradual. I have seen it reach as high as 105° and 106° in cases that were of a benign type. In fact, none of the cases that form the basis of this paper could be considered as belonging to the severe or pernicious form. Such sudden high elevation of temperature may be met with at the onset of a simple attack of indigestion or of pneumonia and sometimes of scarlatina. Dr. Cheadle has reported a couple of cases in which the febrile stage was attended with a rash not unlike that of scarlatina. But in making a differential diagnosis in such cases it must be remembered that the scarlatinal rash does not appear until twenty-four hours have elapsed after the onset of the fever. The fauces in these cases may be red, but the redness has not that peculiar punctiform appearance which is so common in scarlatina; and, moreover, the redness in the fauces is less generally diffused. Then again, the fever of malaria is followed by a period of apyrexia more or less complete.

In central pneumonia, where the physical signs do not develop for two or three days, we exclude malaria by the absence of intermittens in the fever. But as the spleen may be considerably swollen in this disease, as will be shown later on, we have often to wait a few days before we are enabled to make our diagnosis.

Sweating stage.—The sweating stage in children is usually imperfect both as to degree and duration. It may be so slight as to pass unnoticed by the child as well as by the mother. At times, however, it may be quite profuse. Occasionally the mother will say that the child gets feverish sweats, then "dries up into fever," and again sweats. It may go through two or three such phases during a single paroxysm.

Swelling of the spleen.—The spleen enlarges more rapidly and to a greater degree than in adults, owing to the elasticity

* Liebermeister, "Infectious Diseases." Part I. Translated by Dr. Hurd Davis, 1888.

of its capsule in early life. Its enlargement is more important as a diagnostic element on account of the uncertainty and imperfection of the cold and sweating stages. Moreover, it may be accidental only, if the physician gets an opportunity to substantiate with the thermometer the mother's statement that the child has attacks of fever. It is also more important from the circumstance that in early life, no matter how small the dose of poison, it is always sufficient to produce marked congestion and consequent enlargement of the spleen. It is true that at first the organ decreases in volume when the paroxysm is over almost as rapidly as it increases, but after the second or third paroxysm it remains permanently swollen. Hence it may be that, if the child is examined in the intervals of the first two or three paroxysms, no increase of size will be noticed. It is then only in such exigencies as these that a diagnosis of malaria in childhood is justifiable in absence of splenic enlargement. The expression of this seemingly well-known fact might appear superfluous were it not that there is a tendency of late, in high quarters, to cast this sign into the background (Holt, Forchheimer). But the enlarged organ has to be sought for by percussion, and not by palpation, as in adult life, for it may reach considerable dimensions without it projecting beyond the margin of the ribs. The splenic tumor pushes its way upward and backward, because it is usually prevented from descending towards the pelvic cavity by the costo-colic ligament, which, in early life, is very rigid.* I have time and again found the splenic dulness measure, vertically, four inches and more, and yet its lower margin did not reach beyond the eleventh rib. Even when the swollen spleen descends below the margin of the ribs it cannot always be felt as in the adult, owing to the soft consistency of the organ, which has aptly been compared to a sponge, the interstices of which are filled with blood.

To map out an enlarged spleen in a child requires some patience and a considerable degree of practice. I make this statement advisedly, for I have frequently seen skilful phy-

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* Dr. George McClellan, Keating's "Cyclopædia of the Diseases of Children," vol. i. p. 37.

sicians accustomed to the examining of children make the greatest blunders when they came to examine the spleen. This fact must be my excuse for treating at some length this apparently simple matter. The child, perfectly nude or dressed only in its chemise, should be placed on its mother's lap, or, what is better still, on a table or hard level surface, on which a blanket is laid. It should be placed almost on its right side,—that is, in a position midway between the supine and side, with its left arm—held by the mother or an assistant—over its head. It should be seen to that the child does not arch its back, for in that position the spleen is displaced from the side of the chest. The percussion should be begun high up near the axilla and continued downward in a space bounded by the two axillary lines. As soon as a point is reached at which the note becomes dull, or a greater resistance is offered to the finger, a mark should be made with a pencil. This may be taken as the upper border of the spleen. The percussion should be continued lightly until the tympanitic note of the intestines is elicited. In percussing it is very important that not too much force be used in striking the interposing finger, for if this be done the tympanitic note of the stomach and intestines will be brought out through the overlying spleen. The careful physician need not be told that when abnormal dulness in the region just outlined is obtained, the posterior aspect of the chest should always be examined for pulmonary consolidation, or for what is more likely to give a dull note in that area,—pleuritic effusion. I recall an instance when, in the hurry of dispensary practice, after placing the child in the above position, and obtaining a dull note from the fifth rib downward, the diagnosis of an enlarged spleen was about to be made. The diagnosis of malaria would certainly have been entered on the books, for the symptoms pointed to this affection, did not the axiom, which one soon learns for himself in treating children,—"always examine the chest, no matter what the symptoms may be,"—prick my conscience and urge me to follow my usual routine of examining the chest. I found that the dull note, which I took to be the evidence of an enlarged spleen, was caused by a fairly copious purulent effusion into the pleural sac.

There is another error which one may readily fall into, if he does not bear in mind the fact that the lower border of the spleen is in close contact with the left flexure of the colon (Luschka). Hence an accumulation of fæces would give an increase of dulness in the splenic area. I always suspect this when the apparently enlarged spleen does not reach above the upper border of the ninth rib.

But, unfortunately, enlargement of the spleen is not a pathognomonic sign of malaria. It fell to the lot of that able and acute clinician, Friedreich,* to point out that all acute infectious diseases are attended with marked swelling of the spleen. But of these only two,—typhoid fever and acute infectious pneumonia,—from this circumstance, are likely to cause the diagnostician any difficulty. According to this observer, even the milder forms of typhoid are attended with marked enlargement of the spleen,—an observation which I can fully corroborate in the typhoid of the young. The splenic tumor, therefore, bears no ratio to the severity of the disease. On the contrary, it may reach larger dimensions in the mild than in the graver variety. The enlargement takes place early in the disease. It may already be considerable on the second or third day. Indeed, Friedreich† mentions a case in which he noted a large splenic tumor in the initial stage before the thermometer registered any elevation of temperature. The tumor persists after the subsidence of the fever, and it is only after convalescence has been fully established that the organ regains its natural size.

The acute infectious pneumonia of this author is distinguished from the ordinary croupous variety by the local process, which at first may be confined to a small portion of the lung, spreading gradually from day to day, until the whole lung is affected. The fever continues for ten, twelve, and fourteen days. The termination is not by crisis but by lysis, which may spread over several days. Already during the first few days the spleen is markedly swollen, but the splenic tumor differs from that of typhoid by its rapid disappearance on the cessation of the fever.

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* Volkmann's *Klin. Vortrage*, No. 75. † Ibid.

Before leaving this subject, let me draw your attention to a recent paper by Dr. Fichtner,* in which he describes six cases of sudden onset of fever of three, four, and five days' duration that were attended at the outset with marked enlargement of the spleen. One of the cases occurred in a child three years old. An exclusion was made of typhoid fever, but nothing was said about intermittent fever. An examination of the blood was made in one case only. The result was negative. The author claims to have described a new disease, and this claim receives support from Professor Hoffmann, who, in an appended note to the article, states that he witnessed an epidemic outbreak of what he terms *Fichtner's disease* in several members of the same family. But before adding another disease to our already overburdened nosology, it would seem to me that Fichtner should have presented more data, and should have given good reasons for excluding malaria or other infectious diseases.

Hæmatozoa in the blood.—The writings of Laveran,† Marchiafava and Celli,‡ Osler,§ Councilman,|| Shattuck,¶ James,** and others have made every one familiar with the micro-organisms that occur in the blood of patients suffering from malarial poisoning, and it is only necessary for me to treat of them from a diagnostic point of view. But first a few practical hints about the method of obtaining the requisite drop of blood from the finger-pad of a child. So as not to frighten the little one, it is advisable to keep him in ignorance as to what you are going to do, and pretend you are playing with him by tying a soft cord around the last phalanx, in order to produce the necessary congestion in the finger-pad. The pricking should be quickly and deftly done with a sharp-pointed needle, or with—what is better still—a sharp-pointed æsthesiometer,—a suggestion for which I am indebted to Dr.

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* *Deutsch. Archiv f. Klin. Med.*, Bd. xliv., Heft iv.

† "Traité des Fièvres Palustres," Paris, 1884.

‡ "Fortschritte der Medizin," Nos. 14 and 20, 1885.

§ *Brit. Med. Jour.*, March 12, 1887.

|| *Trans. American Physicians*, vol. i., 1886.

¶ *Boston Med. and Surgical Journal*, 1888, p. 450.

** *Med. Record*, January 25, 1888.

James. Let me here, also, express my thanks to this gentleman for his courtesy in examining the blood of some of my cases, and for demonstrating to me the micro-organisms obtained in some of his cases in adult life.

The diagnostic importance of the hæmatozoa or plasmodium malariæ is still a matter of doubt, although the weight of evidence is decidedly in favor of their being of pathognomonic value. In a recent note from my highly-esteemed friend and former teacher, Dr. Osler, it is stated "the evidence is accumulating to show the constancy of the forms and the extreme diagnostic value of Laveran's work."

Still, it must be remembered that micro-organisms resembling those occurring in malaria have been found by Rosenstein in the blood of typhoid-fever patients, by Dujardin-Beaumetz in healthy blood when the evaporation of the serum was for a time hindered, by Hoffmann in pernicious anæmia, and by Pfeiffer in scarlet fever, mumps, and vaccination. James* examined the blood of seventy-six patients suffering from a variety of diseases other than malaria, but including those just mentioned. He states that, in a number of instances, he found micro-organisms which might be mistaken by an inexperienced observer for those met with in malaria, but that any one acquainted with the latter would at once recognize the difference in appearance, which, he says, is marked. So much seems certain that, in order to detect the true forms, one must possess considerable skill and acquaintance with that kind of work. It appears that the hæmatozoa are present only in cases of rather a severe type, or during the paroxysm in less grave forms. Osler has, however, found them in five cases of chronic malaria which did not appear to be very grave. They rapidly disappear on the administration of quinine. Even when present, they are not easily detected, as their number is scanty, and several slides may have to be examined before a single plasmodium is found. I searched for them in fifteen cases presenting unmistakable evidences of acute malarial poisoning. In not a single instance did I succeed in discovering any. A few of these cases were examined

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* *Med. Record*, January 25, 1888.

by Dr. James, but also with negative results. They may, nevertheless, have been present, for it was seldom that a child would allow his finger to be pricked a second time. Hence, as a rule, one specimen only was examined. The likelihood of having to obtain several specimens before meeting with success is a great drawback to carrying out the examination in children.

The therapeutic test.—We are now in a position to discuss the value of quinine as a means of differential diagnosis. Every physician will recall cases in which, after exercising the greatest care and thoroughness in the examination and observation of his patient, he will still be in reasonable doubt as to the nature of the disease before him. In such cases—which are, after all, rare in the practice of the careful and scientific physician—the administration of quinine is justifiable as a means of settling the diagnosis. It has its undoubted value, when properly applied, after we have exhausted all other resources and are still in the dark. But, unfortunately, by the majority of physicians the steps of forming a diagnosis of malaria are taken in the opposite direction. Does the child suffer from chills, lassitude, malaise, headache, etc.,—symptoms common to malaria and a host of other affections,—quinine is indiscriminately given. If the symptoms do not readily yield,—and they do not sometimes, even when due to malarial poisoning, especially in the chronic form,—malaria is excluded, often unjustly. It is then, perhaps, that a thorough examination is made, or the physician goes on groping in the dark trying a variety of remedies in succession, among which anthelmintics figure prominently.

The diseases, in my experience, most likely to be mistaken for acute malaria are acute gastritis and typhoid fever. We have already seen how a mild attack of acute gastritis in a nervous youth may be attended with periodic chills. But in this disease the spleen is not found enlarged. If we adhere to the idea that malaria in childhood is always, with but very few exceptions, attended with swelling of the spleen, we cannot fall into the error of mistaking acute gastritis for malaria. As an illustration of this let me narrate, somewhat at length, the following case:

J. W., æt. three years, was brought to the clinic July 15, 1889, by his mother, who gave the following story: He had always been strong and healthy until four weeks before, when he began to suffer with fever and anorexia. During the first week of illness he had daily three febrile attacks: one in the forenoon, one late in the afternoon, and one at night, each of which was followed by sweating. After that the febrile attacks occurred only every other night. On the day following the febrile night the child would be peevish and out of sorts, but on the second day he would be quite lively and seem fairly well. For the first two weeks he was treated for malaria by a well-known pediatrician, and was given quinine in full doses regularly. But as the child, in spite of this, continued growing worse, the mother became discouraged and left off treatment. After the lapse of two weeks more, and as the child seemed to be getting no better, she decided to bring him to the clinic. At the time of the first visit it was noted, "The child, though fairly healthy looking in the face, shows marked emaciation of the trunk and limbs. The tongue has a peculiar appearance. Running along the centre and occupying about one-third of the width of the dorsal surface is an elevated ridge of a grayish-yellow fur; the remainder of the dorsum is smooth and unduly red. The bowels are constipated, and the abdomen is distended and gives a tympanitic note all over. *There is no enlargement of the spleen.* No fulness in the left iliac region. The inguinal glands are moderately enlarged. The rectal temperature 102.3°. The lungs and heart are normal. An examination of the blood with $\frac{1}{12}$ oil immersion lens gives negative results." He was given four grains of calomel and soda every second night, and a mixture of rhubarb and soda t. i. d. Liquid diet was ordered. Two days later the following note was made: "Child very much improved; abdomen less tympanitic; tongue cleaning; rectal temperature 99°. July 22. 'Quite well in every respect. He has had no fever since he began treatment.' The inguinal glands still seem larger than normal." He continued in attendance regularly every two days, so as to be kept under observation, until August 26. He had remained perfectly well and had gained flesh. The glands in the groin could then scarcely be felt. The temperature was taken at each visit, and was never found to be above 99° in the rectum.

The case was instructive to me in several ways. The emaciation had been so great and the illness apparently so grave—although the little fellow walked about—that at first I suspected tuberculosis of some structure, probably of the peritoneum. I at once excluded malaria from the circumstance that the spleen was of normal size. Typhoid fever was excluded for the same reason. Besides, typhoid fever of four weeks' duration, even if mild, is attended with more physical prostration. Dr. A. Seibert,* in a suggestive article on grave acute gastritis in early childhood, gives the histories of three cases, one of which resembled typhoid fever and another intermittent fever; but the author justly excluded the latter in absence of splenic enlargement. By the majority of physicians vomiting is looked upon as a prominent symptom of gastritis in early life, and as this symptom, in fact, is more often absent than present, the affection is frequently overlooked. Instead of gastritis the diagnosis of "remittent fever," "malaria," and "bilious fever" is not uncommonly made.

In the differential diagnosis of typhoid we receive no assistance from the condition of the spleen, inasmuch as the organ swells considerably in that disease, as has been already fully dwelt upon. Pronounced cases, of course, offer no difficulties, but, in my experience, these are the exception. One meets with cases of "walking typhoid" just as frequently among children as among adults. Scarcely a week passes that I do not see one or two such cases at the Vanderbilt Clinic. Some authors lay great stress on the negative value of herpes labialis as a diagnostic symptom. Liebermeister† and others would exclude typhoid fever in the presence of herpes of the lips or of the nose. On the other hand, herpes of these parts are rather common in acute malaria. Prodromata, although not as frequent an occurrence in the typhoid of children as in that of a more advanced life, do sometimes occur. Of these epistaxis and headache possess the most diagnostic value. In typhoid the temperature-curve will be different. It will show

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* *Jahrbuch für Kinderheilkunde*, 1887. † Loc. cit.

that the exacerbations always occur in the evening, while in malaria they may occur in the forenoon. Further, in typhoid the elevation of temperature is constant; in malaria, excepting in the remittent type, which is seen only in very malarious regions, the febrile attacks are separated by intervals of apyrexia of at least several hours' duration. The appearance of a roseola rash in typhoid is of pathognomonic value. But for this we have to wait twelve days after the onset of the fever, although Jürgensen* states that in the mild cases of typhoid in adults the rash occurs as early as on the fifth day. It is, however, a more constant sign in the typhoid of early life than in that of advanced life. In children the rash is more likely to make its appearance first on the lower part of the back than on the lower part of the front of the chest and abdomen, as in adults. In the majority of cases of typhoid in children the tongue will show the characteristic appearance, the dorsum being coated heavily with a grayish-white fur, while the edges and tip are of a bright red color. Lastly, if we are still in doubt, an examination of the blood should be made. Of course, it is in doubtful cases like these that quinine finds some value as a diagnostic test.

As an illustration of the difficulties sometimes encountered in forming a diagnosis allow me to relate briefly the following case:

M. A., a little girl, twelve years old, came alone to the clinic on August 7, and stated that her health began to fail about two months before, and that for the last six weeks she had had a daily chill followed by fever, but not by sweating. That was all I could ascertain from her. I found her quite anæmic, with a dark yellowish discoloration of the skin. The tongue was coated with a heavy white fur, and the tip and edges were red. She said that her appetite was *nil*, and that for some days she had vomited everything she took, and that her bowels were rather loose. A careful examination revealed dry rhonchi all over the chest and considerable enlargement of the spleen (four inches vertically). Rectal temperature 102°; pulse 120, soft and small. She was told to go to bed and was ordered a milk diet and a mixture of bismuth and

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* Volkmann's *Klin. Vortrage*, No. 61.

hydrocyanic acid. August 9 she called again. Vomiting had ceased, the tongue was cleaning, and the bowels were not so loose. She had no chills ; the size of the spleen was the same ; the temperature was 103°. She was told to continue with the same dietetic regimen, and was given pill quinine five grains t. i. d. August 12 : No change ; splenic enlargement persists ; temperature 102° ; pulse 120 ; a few suspicious spots on the lower part of the chest. She was now given antipyrin as an antipyretic, and was ordered resorcin five grains t. i. d. She was instructed to remain at home and go to bed. My assistant, Dr. Schelpert, kindly undertook to watch the case for me. The temperature ranged from 101° to 103° until the 19th, when it fell to the normal. She called at the clinic on the 23d, and seemed quite convalescent. She made no complaint ; the tongue was clean, appetite was good, and the temperature was normal. The spleen was of normal size. On the 26th she called again, saying that on that morning she had had a chill, and that she felt quite ill since then. I found the rectal temperature 105°, the pulse 120, and the spleen moderately enlarged. She was put upon the former treatment, and in seven days convalescence set in again,—permanently this time.

The case was undoubtedly one of typhoid, which probably had been running for three or four weeks before coming to the clinic. The chills, from which the patient stated that she had suffered daily, were doubtless the chilly sensations which patients frequently experience when they walk about with an elevated temperature. They ceased as soon as the patient was put to bed and before any quinine had been administered, which medicine had no effect whatever upon the course of the disease.

Any doubt that might have been entertained as to the nature of the illness was entirely dissipated when I made a visit to the house during her relapse, and found that the mother was suffering from unmistakable typhoid in the fourth week, from which she has since died.*

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* Since the above was written, three more members of the family have had typhoid fever.

Chronic malaria.—Under this heading I would describe the milder forms of paludal poisoning, which formed at least sixty per cent. of my cases. There may be chills and fever at the outset, which the mother has usually forgotten, unless she is questioned about them, or, what is more frequently the case, the affection is insidious from the beginning. The mother will tell you that the child has been ailing for some time, but she cannot say just when it began to show signs of ill health. I would make a distinction between this form and that of malarial cachexia,—a term which I would apply to the severer forms of protracted paludal poisoning, that met with in very malarious regions. I have had little experience with the latter, and will leave it out of consideration in this paper.

Chronic malaria manifests itself by a variety of symptoms, which may or may not show periodicity. Prominent among these are lassitude, drowsiness, a lack of energy, tiring on slight exertion, headache, dizziness, wandering pains in various parts of the body, chilly sensations, neuralgia of the intercostal nerves, restlessness at night, anorexia, vomiting, constipation, rarely diarrhœa, bloody diarrhœa, emaciation, a dirty brownish-yellow tint of the skin, anæmia, syncopal attacks, urticaria, night-sweats, asthmatic attacks, pain over the region of the spleen.

None of the enumerated symptoms, taken alone or conjointly, justify a diagnosis of malaria. They are met with in a number of other chronic diseases, but notably in chronic dyspepsia and what, for want of a better term, we will call debility, congenital or acquired. Here even more than in the acute form enlargement of the spleen is a *sine quâ non* in the diagnosis of malaria.

Some of the foregoing symptoms deserve special consideration.

Headache.—There is nothing characteristic about the pain in the head which would indicate its pathology. It was not a common symptom in my cases. On the other hand, I have met with this symptom much more frequently in chronic dyspepsia and in children who applied themselves too closely to their studies. I have never observed a case of brow ague, which is so common a feature of chronic malaria in the adult. Eustace Smith* says that it is never met with.

Vertigo is said to be a rare symptom in children, and when it does occur it is considered by many as almost pathognomonic of malaria. It was not present in any of my cases. Bohn only saw it once in four hundred and sixty-five cases. But it was a prominent symptom in two cases of tænia lata that came under my notice. I have not infrequently observed it follow slight concussion of the brain, caused by a fall, which the mother had forgotten until questioned about it.

Bloody diarrhœa.—I have met with it only once. It occurred every night; the child having from four to six stools, consisting mostly of blood. There was no looseness of the bowels during the day. At times this symptom does not exhibit any periodicity, and is distinguished from dysentery by the absence of pain and tenesmus, and by the absence of any considerable quantity of mucus in the stools. Further, in dysentery the spleen is not appreciably enlarged.

Vomiting, as an only symptom, was present in three of my cases, in two of which it occurred periodically, in one daily, and in the other every other day. On the same day that the child with the daily vomiting came under my care at the clinic another child was brought there to me with exactly the same symptom. In the latter case there was no enlargement of the spleen; but on questioning the mother, I learned that the child, some days before, on going down-stairs, had fallen a distance of three or four steps. The vomiting had begun since the fall, and was arrested in a few days by keeping the little one in bed and giving it daily three doses of fifteen grains each of bromide of potassium. Protracted vomiting in early life is not, in my experience, an uncommon symptom following an insignificant fall. In some cases it appears to take on a periodic type, as in the case alluded to.

A peculiar color of the skin.—Much diagnostic importance is attached to a pigmentation of the skin, showing itself in a peculiar "bistre" tint. It probably possesses great value in the severer forms of malarial cachexia, but it is not a charac-

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* Loc. cit., p. 149.

teristic sign in chronic malaria. In none of my cases was it at all striking. In several of them the skin presented that dirty sallow appearance which is common to all affections attended with malnutrition, and in other cases the skin was of the normal hue.

Attacks of syncope.—I have not been able to find any mention of this symptom in the literature of malaria in early life that I have read. It occurred in two of my cases. In one it preceded the onset of the chills; in the other, a little girl four years of age had had no chills, but had fainting spells every day at 11 A.M. The mother stated that the child grew feverish after the syncopal attacks, and that she complained of feeling chilly at night. It would probably have been more proper to have described this symptom under acute malaria as one of the phenomena that may replace a chill in early life.

My friend, Dr. B. Sachs, tells me of a case that he had in private practice, in which a child, four months old, had for five or six successive days several fainting spells, or rather attacks of semi-collapse, in which the child apparently lost consciousness. The eyes rolled up and inward, the body became covered with a clammy perspiration, and the pulse was thread-like. The temperature, taken several times a day, showed moderate elevation (103°) at times, and at other times it was normal. The spleen was but moderately enlarged. The child was on the breast, and there was no evidence of gastric or intestinal disturbance. A diagnosis of malaria was made by exclusion. Quinine was administered, and the baby made a rapid and satisfactory recovery.

Urticaria is said by many to be a common symptom of chronic malaria in the child as well as in the adult. Bohn met with it only occasionally, and then mostly in the acute variety during the paroxysm. I have only twice seen chronic urticaria accompanied by enlargement of the spleen. But in children, chronic urticaria, not of malarial origin, is often cured by full doses of quinine. This circumstance doubtless accounts for the prevalent opinion that the affection is frequently caused by paludal poisoning. It forms a good illustration also of the likely errors in diagnosis that may be committed when much reliance is placed upon the therapeutic test.

Night-sweats.—This is another symptom the mention of which I have not been able to find in literature. It was present in two of my cases, one of which was quite instructive to me. The little girl, six and a half years of age, had always been delicate and had suffered from rickets in infancy, the evidence of which she showed in a pigeon-shaped breast. She had diphtheria eight months before and scarlet fever two months later. There was a loud systolic murmur at the apex, but no increase of cardiac dulness. The lungs were sound and the urine normal. No attention was paid to the spleen. The night-sweats were looked upon by me and by others as due to overheated rooms, to too much bed-covering, and to the delicacy of the child's health. Still, it was thought advisable to keep her under observation for future developments. Under improved hygienic surroundings, and a tonic treatment of several months, she grew considerably stronger and gained in flesh. But the night-sweats persisted, although they became less severe and less constant. About this time I began to make it a part of my routine at the clinic to carefully map out the limits of the spleen in every case. To my surprise, I found that her spleen was considerably enlarged (three inches vertically). She was now put upon a course of quinine and arsenic, and in the course of a few weeks the night-sweats entirely ceased. It is necessary to add that other chronic conditions which might give rise to a splenic tumor were excluded. The heart trouble could not possibly be credited with it, as circulatory disturbances were not present.

The chronic affections in childhood attended with marked enlargement of the spleen are leucocythæmia, lymphadenoma (Hodgkin's disease), and amyloid degenerations of the internal organs. In the differential diagnosis of these affections it must be borne in mind that leucocythæmia and amyloid degeneration may be the sequelæ of long-continued malarial poisoning. They each, however, possess characteristics of their own, and are easily recognized.

Treatment.—My paper has already reached such a length that I can only say a few words on this subject. I will make the confession at the outset that I have not found the cure of malaria—especially the chronic form, in early life—the easy matter that some observers would lead us to suppose. Of course, quinine forms our sheet-anchor. I am in the habit of prescribing it in solution with aromatic sulphuric acid and syrup of lemon. This mixture is ordered to be given in sugar-water. Children seem, in most instances, to take it in this way readily. When it causes vomiting, I add aqua lauro-cerasi. I prefer giving the quinine in two or three large daily doses (five grains to a child five years old) until all acute symptoms subside. After this, a single large dose is given every third or fourth day for a couple of weeks. In the mean time, the remedy is given in smaller doses combined with liquor arsenici chloridi and acidum muriaticum dilutum three times a day for several weeks. In private practice I find that the tablets of chocolate of quinine, each containing one grain of the tannate, is a very pleasant form of administering the drug. I prefer those manufactured by Hazard, Hazard & Co., of New York, to the imported ones, as the chocolate is fresher, and is not so likely to disagree with the child's stomach. Bohn speaks very highly of the tannate salt in the treatment of children, but says it must be given in double the dose that the sulphate or muriate is given. Children at the breast might have the drug introduced into their system by administering it to the mother; but I have no data on this point. I have found that suppositories of quinine act very well where it is impossible to give the quinine by the mouth. I have never tried inunctions. Hypodermic injections should only be resorted to under the most urgent circumstances from their likelihood of being attended with abscess formations. Children are very prone to relapses; and to prevent these, I have had good results with pure nitric acid* in doses of from two to five drops well sweetened and diluted. When the patient comes under treatment, unless he is suffering from actual diarrhœa, it is my custom to give a few purgative doses of calomel combined with soda. It has been a very common experience with me to find that, although all the symptoms had vanished under anti-periodic treatment, the enlargement of the spleen would persist. As it is a well-known fact that relapses are more liable

* This remedy is recommended by Dr. S. M. Bemiss.

to occur while the spleen remains enlarged, and that the chronic congestion may lead to permanent changes of structure, it behooves us to use every available means to bring the organ back to its normal size. Professor Jacobi, in his clinical lectures, recommends for this the administration of ergot. The drug has proved very efficacious in my hands. I gave usually the fluid extract in doses of ten to fifteen minims to a child five years old. It seemed to me that the ergot had no effect upon the malarial poison itself. A few cases of tumor of the spleen resisted even this treatment, and then I resorted to inunctions of ammoniated mercurial ointment over the region of the tumor, and gave strychnine internally. If it is thought advisable to give salines, it will be well to bear in mind an old observation of Glax and Kirch, and which has recently been substantiated by Pollatschek.* These observers noticed that patients undergoing a course of treatment at Carlsbad were prone to have a return of intermittent fever if they had ever suffered from it before.

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DISCUSSION.

Dr. Holt.—There is one point in regard to the presence in malarial cases of splenic enlargement sufficiently great as to be positively diagnosticated of which I wish to speak. It seems to me that there are a large number of cases in children with a history of exposure to malarial poison, with pretty clear symptoms indicating such affection, and curable by quinine, but in which there is not sufficient enlargement of the spleen to be made out by ordinary methods of examination. I have lately made the test of enlargement in infants a sufficient degree of swelling to be made out by palpation. Percussion is often deceptive. The distention of the colon may render it difficult or impossible to be certain about the splenic outline. It seems to me that in the vast majority of cases where the organ is considerably enlarged it can be felt, and that where it is slight we cannot be certain about it. Furthermore, that there is quite a large class of cases of malaria in which demonstrable enlargement is wanting.

Dr. Fruitnight.—The presence of enlargement of the spleen would aid in the diagnosis, but it is hard to be assured in children that the spleen is enlarged. Enlargement of the spleen with the periodicity and other symptoms would be corroborative, but we could not depend upon enlargement of the spleen alone for our diagnosis.

Dr. Jeffries.—Within a week I treated a child who two days after its return from the country had a convulsion. I examined the blood and found the plasmodium. Quinine was then given and the child recovered. In this case the spleen was not found enlarged.

Dr. Holt.—I am sorry that the author has not distinguished between infants and children five or six years of age. In the case of infants many points come up in connection with the diagnosis which are not met with in older children. In the latter the disease runs about the same course as in adults. In young children the diagnosis is often difficult. The one disease with which malaria is most frequently confounded is pneumonia. In some cases it is impossible to say for two or three days whether the child is suffering from pneumonia or malaria. I have now a child under observation who, for the first four days of its illness, showed, upon the most careful and repeated examinations, no physical signs of pneumonia. The temperature would run up to 104° F. in the afternoon and drop nearly to normal in the morning. At the end of four days a small area of consolidation was discovered high in the axilla and at the apex in front.

If we accept the plasmodium as the test of malaria, and the only test, we must admit that the vast majority of cases which we see in New York are not cases of true malaria. Two years ago the blood from quite a number of patients was examined by Dr. W. B. James and myself, and we were not able to demonstrate the plasmodium in a single case in which the disease had been contracted in New York City. The teaching of Dr. Janeway has long been that a case exhibiting well-marked paroxysms was seldom seen in New York City unless the patient had contracted the disease elsewhere.

Dr. Carr.—Looking over the record of four hundred and sixty-four cases seen at St. Mary's Free Hospital for Children, I found only one in which the diagnosis of malaria was made by enlargement of the spleen. In one hundred and forty-two of these cases there were marked signs of gastro-intestinal or intestinal disturbance. In listening to the paper, it seemed to me that many of the symptoms mentioned as being common in chronic malarial troubles were just as common in obstructive gastro-intestinal catarrhs. Those cases with coated tongue, pallor, or peculiar yellowness, emaciation, irregular sweats, and fever are relieved as frequently by mercurials as by quinine. I must say that, in my experience, a mercurial has given the better result. I have not examined for enlargement of the spleen so often as Dr. Vineberg, and doubt whether I could determine the enlargement so exactly.

Dr. Seibert.—For a number of years I have found in every case of malaria a symptom which I believe to be peculiar to that disease,—namely, a greenish coating of the tongue. In severe cases this green is of a very dark shade. In milder cases the shade is lighter. In every case where I see this greenish discoloration, I invariably find enlargement of the spleen. I have found this greenish coating a very valuable symptom, especially in the chronic forms of the disease.

Dr. Huber.—I wish simply to call attention to a remedy that has not been mentioned, and that is, the use of ergot, particularly in cases where the spleen is enlarged. In cases where the diminution of the size of the spleen under quinine has been slow, the use of the fluid extract of ergot has been followed by rapid diminution.

Dr. Fruitnight.—There is one point in the diagnosis of this affection to which I would refer, and that is the imperfect ratio between the fever and the nervous disturbance accompanying the fever; for instance, we may see a child with a temperature of 105° F., and yet there may be no marked cerebral disturbance. The child does not appear to be so ill as the high temperature would warrant. This is an important point in diagnosis.

I have found that pneumonia and typhoid fever are frequently mistaken for this disease. Scarlet fever also is often diagnosticated when malarial disease alone is present. This is due to the fact that a bright, general erythema, caused by the high temperature, is often present. This erythema is not persistent, and soon disappears when the temperature has been reduced.

The President.—In considering this subject we must distinguish, as Dr. Holt has said, between the infants and older children. The older children have the intermittent fever of adults, and it can be easily diagnosticated. In the infant the diagnosis is difficult. In many cases I am not sure that we can diagnosticate malarial fever as well as Dr. Vineberg appears to do. I frequently miss the enlarged spleen. I have seen on the post-mortem table enlarged spleens, which I could not make out during life. I have been often compelled to make the diagnosis of malaria—which I make very seldom—mainly by exclusion.

As far as ergot goes, that is a practical point which may be of importance. I used it some thirty years ago in a case of malarial fever with enlarged spleen, which would not yield to arsenic, quinine, and the iodides. The ergot reduced the size of the spleen and broke up the fever when nothing else could. I have frequently used it either alone or in connection with quinine since I published my first observations, nearly thirty years ago, in the *American Medical Monthly*.

Dr. Keating.—There is probably no branch of the profession which meets with so much competition with homœopaths as we do, and this is seen particularly in the methods of administration of drugs in such diseases as malaria. Undoubtedly sufficient attention has not been paid to methods of dosing and palatability of medicines used for young children. Recent papers, and particularly those of the President of this society, have been of great value in this direction. We are accustomed to give large doses of quinine without paying much attention to the method of administration. This is an important point for consideration. What is the experience of members with the more insoluble and tasteless preparations, such as the tannate? Are they of service? If not, what is the best way of prescribing quinine?

Dr. Vineberg.—The point which I wished particularly to bring out was that enlargement of the spleen is not easily made out in children if palpation is relied upon. I have often found that a spleen which gave a dulness of four inches did not project beyond the border of the ninth or tenth rib. There is an anatomical point which accounts for the fact that the spleen rarely projects below the ribs in children. The costo-colic ligament, on which the spleen rests, is very rigid in early life. Any one who relied upon palpation would overlook ninety per cent. of the cases of enlarged spleen. Very light percussion should be employed to determine the area of splenic dulness. If force is used, you will get the tympanitic note of the stomach or intestine.

Regarding the evidences of malaria in very young children, I omitted that part of my paper in reading it. Under two years of age chills are said never to occur. Instead of these there will be a little blueness of the skin, or the finger-nails will become blue.

The administration of quinine, in private practice, I find to be best carried out by giving the tannate in the form of a lozenge with chocolate. Each tablet contains one grain, and they are readily taken.

In regard to the color of the coating of the tongue. This is a matter which depends largely upon the examiner. I have never been able to detect any peculiarity of the coating of the tongue in cases of malaria.

Dr. Huber.—I have given quinine in the manner recommended by the President,—that is, mixing the dose of quinine with simple syrup at the time of administration. Given in this way the dose is not as disagreeable as if the mixture had been made some time. The quinine can also be given in simple elixir or in the compound elixir of taraxacum.

Dr. Fruitnight.—I usually follow one of three methods in giving quinine according to the age of the patient and the tolerance of digestive organs. In very young children I, as a rule, employ the oleate rubbed into the surface of the body. In older children I suspend the drug in syrup of wild cherry. Where this is vomited, I give it in suppositories. To those children who can swallow them I give the small gelatin-coated pills.

Dr. Caillé.—It must be remembered that it is impossible to hide the taste of quinine when given in solution. The tablets of tannate of quinine contain very little of the specific drug, and I think a sufficient dose cannot conveniently be given in this way. Personally, I get along very well by giving the quinine suspended in compound elixir of taraxacum. Three to five grains can be given in a teaspoonful of the elixir.

Quinine can also be administered by inunction with oleate of quinine. Personally I have had no experience with this method.

Dr. Holt.—It seems to me that all methods of administering quinine in solution are bad. The only difference is in the degree of badness. I have tried various modes of suspending the drug, but with the same result in all. I have used the oleate of quinine by inunction without much success. I have also used the oleate by the rectum, but I think that it is absolutely useless. In cases in which the drug in suspension or in solution is vomited, or will not be taken, I rely on chocolate tablets. These can be used when nothing else will be taken.

Dr. Watson.—I use quinine by two methods. In the first the drug is triturated with an equal quantity of sugar of milk and dispensed in powders, and the mother is directed to mix each dose with a teaspoonful of the syrup of chocolate at the time that it is given.

I have at the dispensary a mixture containing quinine sulphate, one grain; sugar of milk, one grain; powdered licorice-root, one-eighth grain. This, after trituration, is dispensed in powders, and the mother is directed to mix the required number of powders in molasses, chocolate, or coffee at the time of administration. The second method is for the mother to hold the child's mouth open and drop a one-, two-, or three-grain quinine pill into the throat. This is swallowed readily, and answers every purpose. It is my custom to give all the quinine required for the day during the first three or four hours of the morning.

Dr. Latimer.—After considerable experience in the administration of quinine, I have come to the conclusion that the best general vehicle is the fluid extract of licorice. I am also convinced that quinine can be satisfactorily employed by inunction. The best preparation is a solution in oleic acid diluted with vaseline or lanolin. We have heard nothing of the old-fashioned method of giving unpleasant drugs in scraped apple or similar vehicle. This answers very well for older children.

Another method which applies equally to all obnoxious drugs is to have the child instructed in the swallowing of pellets beforehand. I instruct the mothers to practise the children in the swallowing of pellets of sponge cake, sugar pills, and the like. When they learn to do this, pills or capsules can be readily taken.

Dr. Carr.—The yerba santa preparations of the National Formulary, an aromatic elixir and an aromatic syrup, are more palatable than the taraxacum. In hospital practice the fluid extract of licorice answers very well, although not so good a vehicle as the yerba santa.

The President.—The tablets to which reference has been made contain, I think, not the tannate but the sulphate of quinine. The effect is therefore an active one. One grain of the sulphate is equivalent to two and a half grains of the neutral tannate. Four or five grains of quinine can be readily taken mixed with chocolate. Coffee is also useful. Ten grains can be easily taken in two tablespoonfuls of black coffee. Syrup of coffee can also be employed with advantage. The quinine and the vehicle should not be mixed until the time of administration. Although it requires seven hundred and eighty parts of water to dissolve one part of quinine, yet a small quantity of quinine will make the mixture as bitter as a larger quantity.

The method by inunction was recommended some twenty-eight years ago. The objection to that is that you cannot determine the dose. The oleates also irritate the skin in a short time.

CONGENITAL MALFORMATION OF THE HEART, RESEMBLING DEXTROCARDIA: ENTIRE ABSENCE OF THE SEPTUM VENTRICULORUM: PULMONARY STENOSIS, AND PATENT FORAMEN OVALE.

BY L. EMMETT HOLT, M.D.,
New York.

Male child, fifteen months old when admitted to the Randall's Island Hospital, March 27, 1889.

On admission he presented the usual symptoms of marked cyanosis; there were lividity of the lips, blueness of the nails, and a leaden hue to the whole face. When the child cried the skin became of a dark, almost purple, color. There was no clubbing of the fingers or toes.

Physical examination of the chest showed the apex-beat of the heart to be one-half inch to the left of the *right* nipple, and about the same distance below it. There was dulness from this point to the left edge of the sternum, reaching as high as the second interspace. The area of normal cardiac dulness to the left of the sternum gave pulmonary resonance. The resonance was likewise normal over both lungs, front and back.

On auscultation, good respiratory murmur was heard over the whole left lung; and also over the right, excepting in the area of dulness previously noted. There were no râles, no friction sounds, and no evidence of antecedent or existing pulmonary disease.

A loud systolic murmur was heard, with greatest intensity in the second left intercostal space, at the sternal border; it was also quite loud at the apex of the heart, and was transmitted rather upward towards the left shoulder than in other directions. It was distinct over the whole chest in front, but could not be heard behind.

The liver was in its normal position, as made out by percussion; likewise the spleen.

There was very little objective dyspnœa.

The child's general condition was poor: he had ten teeth, was unable to stand, but gave no evidence of any active disease.

The mother stated that he had been a "blue baby" from birth; that he had never suffered from any acute illness,—pulmonary or otherwise,—and that the cyanosis was stationary, and had been for a long time.

The child remained in the hospital for six weeks without any visible change in the symptoms, and no variation in the physical signs.

He then developed acute pleuro-pneumonia of the left lung, from which he died May 1.

There was nothing noteworthy about this attack except that his temperature was quite low, being rarely over 101°. The prostration was great, however, and he died quite suddenly of heart-failure, when apparently improving.

Autopsy, thirty-six hours after death.

Upon opening the chest the heart was found deflected to the right about as much as it is usually to the left. The middle lobe of the right lung was hollowed out for its reception, while the anterior border of the left lung was straight.

The right lung was normal; pleural cavity empty.

The left pleura contained about one ounce of brown serum, and the whole lung was thickly coated with a shaggy layer of fibrin and pus. The lower lobe was completely consolidated, giving, upon section, the usual appearances of lobar pneumonia.

The abdominal organs were essentially normal.

In size, shape, and external appearance the heart did not differ essentially from the normal, except that its anterior landmarks were all reversed.

Upon opening the organ it was found to consist of but three cavities, two auricles and one ventricle. The septum ventriculorum was represented by an elevation in the wall about one-fourth of an inch high, forming a slight ridge which divided the floor of the cavity into two unequal parts; the left, consisting of about one-fourth, contained a blind pouch about one inch in depth, evidently the rudimentary left ventricle.

The right portion of the ventricular cavity contained three openings: at its upper portion the tricuspid orifice, measuring one-half inch in diameter; a little below and to the left the pulmonary opening, scarcely one-fourth of an inch in diameter; still lower the mitral orifice, five-eighths of an inch wide, and reaching to the left as far as the ridge. At the upper part of the common ventricular cavity opened the aorta; being given off in a direction about on a line with the ridge marking the rudimentary septum.

The mitral and tricuspid valves had the usual number of segments, and these had a normal appearance. Those of the pulmonary valve were much thickened and small, but not otherwise deformed. The aortic valves were normal. The wall of the common ventricle was of nearly uniform thickness throughout.

The aorta was normal, as were also its primary branches. It measured five-eighths of an inch in diameter.

The pulmonary artery was relatively very small, measuring one-fourth of an inch in diameter; and there was, besides, stenosis of its orifice.

The ductus arteriosus was closed.

The right auricle was normally placed, but its capacity was only about two-thirds that of the left. The superior and inferior venæ cavæ opened normally.

The left auricle was placed almost entirely behind. Into it the pulmonary veins opened, as usual.

The foramen ovale was patent, the opening between the auricles being one-half inch in diameter.

There were no other malformations found.

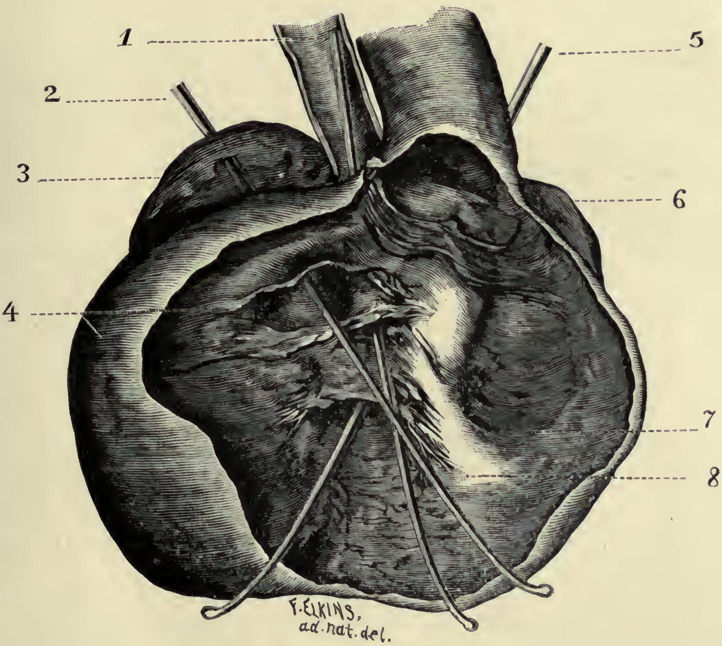
Explanation of the wood-cut.—The organ has been spread open, showing the greater part of the common ventricle. The probe "1" passes from the pulmonary artery, through the pulmonary opening, into the ventricle. The probe "5" passes from the left auricle through the mitral orifice; "2" passes from the right auricle through the tricuspid orifice, "4." The ridge indicating the rudimentary septum is shown at "8;" the rudimentary cavity of the left ventricle at "7." The left auricle is indicated by "6;" the right by "3." The relative size of the aorta and pulmonary arteries is well represented. The drawing is life-size.

Remarks.—During the life of the patient the diagnosis was made of congenital cyanosis, depending chiefly upon pulmonary obstruction, with probably a transposition of the heart.

The writer has not met with an exactly parallel case in medical literature. The malformation was certainly of very early origin in the development of the heart. The two primary factors seem to be failure in the formation of the ventricular septum, and a very small pulmonary artery with stenosis of its orifice. Which of these two came first, or whether they were coincident, it is impossible to say.

The circulation appears to have been a curious mixture of the fœtal and the adult types. The greater part of the blood entering the right auricle by the inferior vena cava evidently passed through the wide foramen ovale, as the valvular septa there existing would naturally give the current that direction. In the left auricle this venous blood was mingled with the arterial blood from the lungs. The entire force of the circulation, both systemic and pulmonary, was then carried on by the single ventricle.

The cyanosis was no doubt due, in great measure, to the pulmonary stenosis and small pulmonary artery rather than to



CONGENITAL MALFORMATION OF THE HEART, RESEMBLING DEXTROCARDIA.

the commingling of the blood-currents. It is difficult to understand in such cases as this how the pulmonary circulation could be carried on so well as the symptoms indicate that it was. It is strange, also, that a child should live to be sixteen months old and suffer so little inconvenience.

The deflection of the heart to the right is manifestly due to the overgrowth of the right ventricle, just as in the normal heart the overgrowth of the left ventricle deflects the organ to that side.

DISCUSSION.

DR. NORTHRUP.—Dr. Osler has just placed in my hand his article on heart anomalies;* and in it, after speaking of reptilian hearts, he refers to a case reported by myself which is similar to the one just presented. The child was a blue baby that lived one month. There was one auricle and one ventricle, with entire absence of the pulmonary artery. In this case the left lung had the customary two lobes and the right lung had three. The heart was deflected to the right side at the same angle that it normally bears to the left.

15 EAST FIFTY-FOURTH STREET.

A CASE OF ATAXIA IN A CHILD TWELVE YEARS OF AGE.†

BY A. D. BLACKADER, M.D.,
Montreal.

WILLIAM JACOTEL, aged twelve years, is the second of a family of ten children, of whom seven are now dead. Four of these died during an epidemic of diphtheria in 1885: the eldest, a lad of ten years; the fourth, a lad of five years; the fifth, a lad of nearly four years; and the sixth, of a little more than two years. All of these were said to have been in good health, strong and active, before attacked by diphtheria. The seventh, a child of three years, died six months ago from scarlet fever. The third, an infant of nine months, is said to

* Keating, "Cyclopædia of the Diseases of Children," vol. ii. p. 751.
† Read by title.

have succumbed to an attack of erysipelas in 1879. And this summer, the youngest, an infant two months old, was carried off by diarrhœa. The three survivors are William, of whom we are now speaking, a girl of nearly four years, and an infant sixteen months old. Both the younger children are at present in good health, with no impairment of the knee-jerk, and no apparent loss of power in the lower limbs.

Both father and mother are said to be in fair health at present. On neither side is there any history obtainable of any relative who suffered from an impairment of gait due to nervous disease. They all appear to have reached a good old age. There is no history either of any special neurosis, syphilis, or tuberculosis. The father and mother are not blood relatives. The father occasionally indulges in alcohol to excess.

William is said to have been quiet as a baby; was nursed till the tenth month, but was late over teething. There is no history of any convulsions, but as an infant of two years he had a fall, cutting the front of his forehead. This has left a distinct scar involving the bone, still quite discernible on the top of the forehead, a little to the right of the median line. Since the age of five years he has suffered severely from headaches resembling those of migraine. They are described as lasting three or four hours, and as being generally on the same side of the head as the scar; they were usually associated with vomiting, and passed off during a night's sleep. They recurred somewhat regularly three or four times a month, but were induced by any excitement. Although still recurring occasionally, they are much less severe than formerly. The first distinct symptom of the present illness was noticed six years ago as an unsteadiness in his gait, producing occasional falls, and the lad was in consequence pronounced, by a physician who saw him, to be suffering from St. Vitus's dance. This weakness and staggering gait have gradually become worse, and for this he was brought to the Out-Patient Department of the Montreal General Hospital last June. The strictest inquiry does not elicit any history of true lightning pains. Two or three years ago his mother first noticed some alteration in his speech, and this also has gradually become more marked.

At present he is a fairly-nourished lad, four feet five inches tall, weighs eighty-five pounds, with distinct talipes equinus in both feet and slight curvature in the spine. There is a well-marked ataxic gait. In walking, the body sways from side to side, the legs are widely separated, and the feet are thrown forward. On standing the feet are kept much apart. If placed together there is much swaying of the body, which is only slightly increased by closing the eyes. A very fair attempt is made at walking backward. There is also distinct ataxia in the upper extremities, though much less marked than in the lower. If asked to touch his nose or tip of the ear with his finger quickly, he is generally an inch or two at fault; but he makes a fair attempt at picking up a pin, even with his eyes closed. There is complete absence of patellar reflex, but the cutaneous reflexes are only slightly diminished. There is no muscular atrophy, and no spastic rigidity. Speech is distinctly jerky, with an abrupt pause between the several syllables, and occasionally elision of the last consonant. This is much less marked in reading than in speaking. There are no abdominal or thoracic symptoms; urine is normal; bowels regularly moved daily; sleep generally quiet; no nocturnal enuresis, but his mother states that he takes longer to pass his urine now than formerly. Pulse, while standing, 84,—regular. Intelligence unimpaired.

The following is the report of an examination of the eyes by Dr. Stirling:

"Vision normal; accommodation active; pupils even, oscillating three mm. Color vision normal; field free; fundus, slight posterior staphyloma, vessels slightly smaller than usual; no nystagmus, but some slight ataxia of muscles of eyeball."

Dr. Wharton Sinkler (*Med. News*, July 4, 1885) relates a very similar case, in which there appears to have been also some interference with the urinary centre.

During the past few years the disease known as Friedreich's ataxia has been fully recognized by the profession, and instances of its occurrence have been recorded from time to time in the medical journals, so that the salient points of difference between it and Duchenne's tabes dorsalis are now generally acknowledged. "Transitional cases," as Dr. Ormerod calls them, are, however, always interesting, and those mentioned by him in his "Critical Digest" (*Brain*, vol. vii. pp. 111) are still amongst the most noteworthy. Amongst these is the case observed by Carré, in which there was well-marked heredity and an affection of speech, yet the disease began with numbness in the feet and legs, at the age of twenty-two years, and diplopia was observed. In the three cases reported by Dreschfield there was also distinct heredity, yet they resemble the classical type in the age at which the symptoms appeared and in the neuralgic pains with which the onset was marked. In Powers's case vomiting appeared among the early symptoms.

In my own case the symptoms point to disease confined almost entirely to the posterior columns, but involving also the medulla. Cerebellar disease would appear to be excluded by the history of the case, the absence of occipital pain, the absence of optic neuritis, the absence of the patellar reflex, and the presence of the ataxia in the upper extremities. The age of the lad (six years) when symptoms of ataxia were first noticed, the impairment of speech, the absence of lightning pains, of any alteration in the pupillary reflexes, would oppose its being classed as a case of true tabes.

The possibility of insular sclerosis, occurring with somewhat similar symptoms, must not be forgotten; but in my patient this appears to be excluded by the history of the case, by the absence of any paresis or spastic rigidity, and by the absence of any eye symptoms. It differs from most of the recorded cases of Friedreich's disease, in the absence of any other known case occurring in the family, in the history of previous migraine, and in the presence of symptoms indicating some paresis of the bladder.

TWO CASES OF SPASTIC PARAPLEGIA IN THE SAME FAMILY.

BY THOMAS L. LATIMER, M.D.,

Baltimore.

Case I.—W. L., aged twenty years, was observed first when old enough to walk to be unable to do so, and for some indefinite time thereafter walked only on hands and feet. He was between two and three years old when able to stand alone, and from that time forward has grown steadily, though slowly, worse. About eighteen months ago he was first seen by the writer, and was then substantially in the condition now present.

Present condition.—All parts of the body above the pelvis fairly developed for one leading an inactive life; arms and hands used freely and with perfect voluntary control. His general health is excellent, appetite and digestion good; sleeps soundly; intelligence good for one brought up without instruction. His speech is a little slow and thick. Occasionally has involuntary discharges of urine and fæces. Both lower extremities are distorted. When sitting the knees are in contact and cannot be separated more than five inches without violence, and the great toes are inverted and nearly in contact at the tips, the heels slightly raised from the ground. When he stands the muscles of his legs become tremulous and both legs rotate inward, the right most. In walking he is obliged to cling to objects for support, and as each foot is in turn raised, it is not only powerfully adducted but is rotated inward, the right especially, until the great toe points somewhat backward. When the foot is carried forward it catches behind the opposite leg. This strong adduction and rotation gives to his progression the appearance of climbing up and rolling around himself. This is especially marked when the right leg is brought forward. There is little, if any, wasting. All the muscles of the lower extremities are rigid and are often agitated in his own attempts at locomotion. Knee-jerk and ankle clonus greatly exaggerated. No sensory disturbance. Electrical reaction normal or possibly slightly diminished.

Case II.—D. L., sister of Case I., aged eighteen years, admitted to Nursery and Child's Hospital, June 6, 1888, with well-marked spastic condition. Her general health has always been excellent. Her inability to stand and walk at the proper age first called attention to her condition. After beginning to walk she did so slowly and laboriously. This condition continued with but little observed change until she was about fifteen years old, when the crossed-leg gait was first observed. When admitted to the hospital she presented the condition of robust health now present. The whole of her body, including lower extremities, is plump and well developed. Lower extremities are blue and somewhat cold to touch. Sits with knees in contact, toes inverted, and heels well raised. By using considerable force her knees may be separated about four inches only. In standing and walking her toes become more inverted and heels more raised; her walk is waddling and duck-like, and as if dragging a ball and chain, and her arms are flexed at elbows and held in position like a professional pedestrian. She is decidedly sway-backed. Toes of right foot catch badly at calf of left leg. Knee-jerk exaggerated; ankle clonus readily produced. Tapping patella ligament of one side often causes tremors of the opposite side. Her intelligence is good; she is of amiable temper, industrious, and altogether a well-behaved young girl. Her speech is easy and distinct. Sphincters entirely under control, though until ten years old she had involuntary micturition by day only. Menstruation regular and of normal quantity. There is no sensory disturbance whatever. Superficial reflexes normal. The skin seems hypertrophied; no other trophic disturbance.

On September 27, 1888, her adductors were divided by Dr. Bevan and the legs kept widely separated until the incisions healed. Immediately after the division her legs could readily be separated to almost a right angle with the body; they were kept twenty inches apart at the knees until the cuts were well. The crossed-leg movement is still present since the operation, but to a much less extent, and when sitting she can now voluntarily separate the knees fourteen inches, though the legs are still strongly adducted. Her heels and toes now rest on the ground in walking; it would seem as if lessening the tension of the adductors had lowered the general muscular tension. In no other particular does her present condition differ from that presented on admission.

The mother is living, in good health, and says no special trouble was experienced at the birth of either child; no instruments were used. Neither child has ever had fits, nor is there any history of acute disease antecedent to this condition.

She has one other son, younger than either of these, and two daughters; one younger and one older than either patient, all in excellent health.

These cases are especially interesting as presenting the only instance of which I have knowledge of two cases occurring in the same family. Dr. Gee, of London, writes Dr. Osler that he knows of no instance in which two members of the same family have been similarly affected, and Dr. Osler informs me he has also failed to observe such an occurrence. No cause for the existence of this condition has been found in either case, unless we consider chronic alcoholism in the father a predisposing cause.

In these cases we see pure cases of spastic paraplegia uncomplicated with any associated disorder. No organ or function of the body, except those necessarily involved in the paraplegic condition, appears to be affected, except the slight thickness of speech and the involuntary micturition and defecation in Case I., and the involuntary micturition in the early history of Case II., and the hypertrophied skin.

A STUDY OF SOME OF THE BACTERIA FOUND IN THE FÆCES OF INFANTS AFFECTED WITH SUMMER DIARRHŒA. (*Second communication.*)

From the Pathological Laboratory of the Johns Hopkins University.

BY WILLIAM D. BOOKER, M.D.,

Baltimore.

THIS study was commenced in the summer of 1886 with the view of learning—

1. The species of bacteria existing in the diarrhœal fæces of infants.

The difference between these bacteria and those found in the healthy fæces of infants.

What, if any, species of bacteria appear constantly in the diarrhœal fæces.

The difference in the bacterial vegetation of the fæces of different forms of summer diarrhœa and in mild and serious cases.

The predominating form of bacteria in each case.

2. The biological and pathogenic properties of the bacteria isolated.

The first communication upon this subject was read before the Section of Diseases of Children of the Ninth International Medical Congress, and contained a description of eighteen varieties of bacteria isolated from the fæces of sixteen infants affected with summer diarrhœa.

This article is a continuation of the first, embracing subsequent work, and contains a description of the bacteria isolated from the fæces of fourteen children affected with summer diarrhœa.

The bacteria were isolated by introducing a sterilized glass tube into the anus and inserting through this a smaller and longer tube into the rectum. A discharge from the intestine occurs in a short time, filling the inner tube, which is first withdrawn and emptied immediately into a sterilized test-tube containing bouillon.

A systematic isolation of all the species of bacteria was made as far as this could be accomplished with our present methods.

Agar-agar formed the chief medium for separating the bacteria; gelatin was used in addition to agar in some cases, but frequently the atmospheric temperature was too high for even fifteen and twenty per cent. gelatin.

Colonies having the slightest difference were transplanted into stab cultures, the number of cultures from individual cases varying from five to twenty. Many of the cultures, however, were duplicates, and the cultures never represented more than eight or nine varieties of bacteria from any one case. Corresponding to the previous results the largest number of varieties were found in cases of cholera infantum.

In addition to the ordinary methods for differentiating bacteria, others were used, as acid gelatin, milk litmus reaction, etc. With these methods varieties were separated that could not otherwise be distinguished.*

The identification or differentiation of the cultures made from each case proved such a serious undertaking that, as yet, I have been able to test the pathogenic properties of only a few of the varieties of bacteria.

Before giving a description of the bacteria isolated it may be well to briefly review the work done by others on this subject in the past two years.

The fundamental work of Escherich upon the bacteria in the healthy intestine of sucklings has, in the main, been confirmed by the subsequent investigations of Baginsky and others. Baginsky,† however, has made a more especial study of the chemical and biological properties of the two constant

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* For full particulars of the methods used in this investigation, see the original article in the *Transactions of the Ninth International Medical Congress*, vol. iii.

† Baginsky, "Ueber Gährungsvorgänge im kindlichen Darmcanal und die Gährungstherapie der Verdauungskrankheiten," *Deutsche Med. Wochenschr.*, 1888, and *Zeitschrift f. Physiologische Chemie*, Bd. xiii. Heft 4.

or obligatory milk-fæces bacteria, and reaches somewhat different conclusions from Escherich in regard to the action of these bacteria upon milk-sugar.

Baginsky finds that bacterium lactis aërogenes—the constant bacterium of the healthy small intestine of milk-fed infants—produces an acetic acid fermentation of milk-sugar, and not, as supposed by Escherich, a lactic acid fermentation; only a minimum quantity of lactic acid being formed with simultaneous entrance of aceton. The gases accompanying the acetic acid fermentation are carbonic acid, methan, and hydrogen. This acetic acid fermentation proceeds as well without as with oxygen, and is not hindered by the presence of bile ingredients. From these facts Baginsky concludes that in the intestinal tract, where bile is present and oxygen, as a rule, deficient, the same kind of fermentation takes place.

Bacterium coli commune—the constant bacterium of the healthy large intestine of sucklings—gives rise to lactic, acetic, and formic acids in its action on milk-sugar.

The difference in the action of the two obligatory milk-fæces bacteria upon milk-sugar consists in bacterium lactis aërogenes producing chiefly acetic acid, while bacterium coli commune produces, besides acetic acid, a considerable quantity of lactic and formic acids.

In examining the stools of children having acid diarrhœa, according to Koch's culture method, Baginsky succeeded in separating two species of bacteria which liquefy gelatin, one of which produces a green coloring matter and is frequently found in water, the other being non-chromogenic. The latter was found constantly in the diarrhœal stools, and proved quickly fatal to animals, and Baginsky thinks it probably plays an important *rôle* in the pathogenesis of diarrhœa.

Interesting experiments were made to prove the behavior of this bacillus with the bacterium lactis aërogenes. If the two are inoculated at the same time upon gelatin supplied with milk-sugar, the bacterium lactis aërogenes shows an active development with evolution of gas, while the white liquefying bacillus ordinarily does not develop and but exceptionally causes a liquefaction in the gelatin. This led Baginsky to the opinion that bacterium lactis aërogenes, under conditions most favorable to its growth, can prevent the development of pathogenic organisms, and that we have, in the acetic acid fermentation of milk-sugar by bacterium lactis aërogenes, a remedy which serves in the infant organism to protect the intestinal wall from pathogenic bacteria. When, however, this fermentation exceeds a certain degree, which may happen in abnormal conditions of the intestine, it destroys the bacterium lactis aërogenes and lays the foundation for pathological processes of various kinds.

Lesage* has separated from the fæces of infants affected with green diarrhœa a bacillus to which he attaches considerable importance. He distinguishes two forms of green diarrhœa,—bilious and infectious. In the bilious diarrhœa the green color depends upon an over-abundance of bile and the presence of an abnormal quantity of bile coloring matter. It appears ordinarily between the fourth and twenty-fifth day, and is without further phenomena of disease. In the infectious form of green diarrhœa the stools contain only a small quantity of bile ingredients and are neutral or weakly acid. The green color is produced by a definite bacillus contained in the intestinal contents and stools of children affected with this form of diarrhœa. The bacillus is found in large quantity in the upper two-thirds of the small intestine, more sparsely and in long threads in the large intestine and stools. It is a rounded-end bacillus 2–3 μ long and 1 μ wide, and grows by division and spore formation. The latter has only been observed outside of the body in gelatin at 20°–22° C.

The most conspicuous property of the bacillus is the production of a green coloring matter, soluble in water, becoming a darker green when exposed to air. The green color is produced in cultures on different nutritive media, and in gelatin it diffuses through the whole tube. The bacillus does not liquefy gelatin.

No results were obtained when the bacilli were injected into lower animals subcutaneously, but when injected into the blood they appeared in the duodenum in from ten to twelve hours,

* Lesage, "De la diarrhée verte des enfants du premier age," *Bulletin Méd.*, xxvi. 10, 1887.

and caused by their increase in the intestinal contents the green diarrhœa. The same results were obtained when the bacilli were injected directly into the intestine or fed to animals indifferently as to the gastric juice being normal or not. The acidity of the gastric juice hinders growth, but does not destroy the bacilli. The experiments were only successful in young animals.

In the mild form of diarrhœa there are no morbid phenomena beyond the green color and increased number of stools. The severe form may appear as cholera infantum, with a large number of stools and pulmonary and nervous complications.

The bacillus is not found in water or milk. It spreads in the air from the drying diaper and is taken into the mouth in breathing.

The epidemics of Saint-Antoine Hospital dated each time from the entrance of a patient suffering with green diarrhœa, independent of the time of year, and attacked both breast- and artificially-fed children.

CONDITION OF THE CHILDREN FROM WHOM THE CULTURES WERE OBTAINED.

The children from whom the fæces were taken for examination were chosen from two thousand children sent to "The Thomas Wilson Sanitarium" in the summer of 1888, affected with summer diarrhœa, with special reference to the severer forms of diarrhœa. Four of the children had cholera infantum, seven catarrhal enteritis, and three dysentery. It must not be understood, however, that sharp lines of distinction between these conditions can always be drawn, but that the cases are arranged according as the symptoms approach more closely the classical description of one or other of these affections.

Under cholera infantum are embraced cases having frequent vomiting, usually after anything is taken into the stomach; frequent watery and often offensive stools; wasting of flesh; more or less collapse; nervous phenomena, such as drowsiness, stupor, or great restlessness. High fever accompanying these symptoms was not observed, the rectal temperature being usually about normal and never over 102° F. While these cases do not answer fully to what is regarded as cholera infantum by most of the American authorities, they resemble that affection in the greater violence of the symptoms and in showing the effect of some toxic agent.

Under catarrhal enteritis are included cases in which nervous disturbance is not marked, vomiting occurring only occasionally or not at all, the stools not uniform, but composed of lumps in a fluid or semifluid menstruum, often showing under the microscope epithelial and small round cells mixed through the fæces; the stools less frequent than in cholera infantum.

DESCRIPTION OF THE INDIVIDUAL CASES.

Case XX.—Five months old; milk diet; sick two weeks; greatly reduced in flesh; stupor for the past two days; vomits everything taken into the stomach; stools frequent, whitish-yellow fluid, offensive odor, alkaline reaction, and composed chiefly of bacteria; pulse small and frequent.

Case XXI.—Two months old; milk diet; sick two weeks; emaciated; vomiting; stools frequent, a dark-brown fluid, offensive odor, alkaline reaction, composed of small round cells, bismuth crystals, fungi, and immense quantity of bacteria; pulse feeble and frequent.

Case XXII.—Eight months old; milk diet; sick three weeks; emaciated; drowsy; vomiting everything taken into the stomach; stools frequent, whitish fluid with white lumps, containing a large number of bacteria; pulse feeble and frequent.

Case XXIII.—Nine months old; milk diet; sick three weeks; greatly reduced in flesh; stupor; rapid, feeble pulse; constant movement of the tongue; slight fever; vomiting; stools frequent, a dark-brown fluid, offensive odor, and contain a large quantity of bacteria.

Case XXIV.—Eight months old; milk diet; sick two weeks; reduced in flesh; lies in stupor; vomiting everything taken into the stomach; stools not frequent, six to eight daily, composed of small white lumps in a greenish fluid, offensive odor. Unmistakable symptoms of tubercular meningitis developed in this case a few days after the cultures were made from the fæces.

Case XXV.—Five months old; milk diet; sick one month; emaciated; stupor; vomiting; stools frequent, watery, and greenish color. Symptoms of tubercular meningitis developed a few days later.

Case XXVI.—Eight months old; milk diet; sick three weeks; emaciated; stools frequent, white fluid with white lumps, containing a large number of cells mixed through the stool, few animalculæ, and an immense number of bacteria.

Case XXVII.—Ten months old; milk diet; sick five days; but slightly reduced in flesh; stools green with white lumps, and not frequent.

Case XXVIII.—Ten months old; milk diet; sick three weeks; emaciated; stools not frequent, grayish-brown color, offensive odor, and liquid.

Case XXIX.—Five months old; milk diet; sick six weeks; emaciated; stools frequent, with white lumps in greenish fluid, lumps covered with mucus.

Case XXX.—Five months old; milk diet; sick six weeks; emaciated; stools frequent, composed of white lumps in a greenish fluid.

Case XXXI.—Twenty-one months old; mixed diet; sick with catarrhal enteritis for two months and dysentery for three days; emaciated; restless; stools very frequent and painful, containing blood, mucus, and a small quantity of greenish fæcal matter; only a few bacteria.

Case XXXII.—Ten months old; chiefly milk diet; sick one week; reduced in flesh; stools frequent, painful, and accompanied with straining, containing blood and mucus with green lumps; only small quantity of bacteria.

Case XXXIII.—Twenty-three months old; mixed diet; sick three days; not reduced in flesh; stools frequent and composed of blood and mucus.

Some of the cultures from Cases XXII., XXIII., XXVI., XXVIII., XXIX., and XXXII. were lost through insufficient renewal before being identified.

BACTERIA SEPARATED.

Nineteen varieties of bacteria have been isolated, all of which belong to the bacilli. Four varieties liquefy gelatin, the others do not liquefy it. Four varieties have been previously described,—viz., bacterium lactis aërogenes, bacterium coli commune, proteus vulgaris, and bacillus A. Fifteen varieties are not recognized among the bacteria described in the original communication. These are designated by the small letters of the alphabet. Thirteen varieties are inconstant, each variety appearing but once or twice.

Seven varieties—*d*, *e*, *f*, *g*, *h*, *k*, *m*—closely resemble bacterium coli commune in morphology and growth in agar, neutral gelatin, and potato, but by means of other tests, to be later described, a distinction can be made between them. It is quite probable, however, that they belong to the same group of bacteria as the bacterium coli commune.

On account of many slight variations observed in cultures of the bacterium coli commune, Escherich suspected that he was dealing with a number of varieties of bacteria and not one special variety. Considering this view to be correct, and regarding the above-mentioned varieties as belonging to the colon group of bacteria, some member of this group was found in all of the cases, and two or more varieties of this group were sometimes found in the same case. In catarrhal enteritis they were the predominating form of bacteria, especially in the milder cases; but in cholera infantum they were not the most numerous bacteria, and appeared in diminished quantity according to the severity of the disease.

Whether certain varieties of this group of bacteria appear more frequently in the diarrhœal than in the healthy milk fæces is a difficult question to solve. The variety corresponding in all respects with the culture of bacterium coli commune sent to me by Escherich was isolated from a larger number of cases than the other varieties. One variety was only found in two cases of dysentery, and in both cases as the predominating form. This variety differed from the others of the group in not thriving on acid or sugar gelatin.

Bacterium lactis aërogenes was found in all of the cases, and in many cases in large quantity, but never as the predominating form. A bacillus corresponding in nearly all particulars with bacterium lactis aërogenes, but differing from it in not coagulating milk, was found in one case. While this bacillus had no apparent action on milk, it produced a more active development of gas-bubbles on potato cultures than the bacterium lactis aërogenes.

Two of the varieties of bacteria which liquefy gelatin, proteus vulgaris and bacillus A, were found in cases of cholera infantum and not in the other cases. Bacillus A belongs to the proteus group of bacteria, and resembles proteus vulgaris in many respects. They have similar floating, twisted colonies in gelatin and similar pathogenic properties, but differ in milk litmus reaction and growth on potato. In the absence of a culture of proteus mirabilis for comparison with bacillus A, the relation between these two has not been decided.

Bacillus A is described in the original communication, having been found in four cases of cholera infantum. When it was first studied, 1886 and 1887, comparisons were not made with proteus vulgaris, and as it is difficult to distinguish these two varieties without careful comparison, it is probable that cultures from some of the four cases regarded then as identical with bacillus A may have been proteus vulgaris.

Table II. shows the distribution of the bacteria.

Table I. is taken from the original communication in the *Transactions of the Ninth International Medical Congress.*

DESCRIPTION OF THE INDIVIDUAL SPECIES OF BACTERIA.

PROTEUS VULGARIS.

Found the predominating form in three cases of cholera infantum. In the case of cholera infantum in which it was not found a number of the cultures were lost from insufficient renewal before they had been differentiated.

Morphology and biological characters.—It appears identical in every respect with Hauser's proteus vulgaris. It liquefies gelatin and blood serum, is a potential anaërobic, and in morphology and character of growth upon different media it cannot be distinguished from proteus vulgaris.

Pathogenic properties: direct injection into the intestine.—The experiments were made upon half-grown rabbits with the body immersed in a bath of normal salt solution kept at a constant temperature of 38° C., according to Sanders-Ezn's method. The abdomen was opened along the linea alba and 1 c.c. of an

TABLE I.*

Showing the distribution of the bacteria.

BACTERIA.	CHOLERA INFANTUM.							CATARRHAL ENTERITIS.						DYSENTERY.		Beginning Diarrhœa.	Healthy.
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.
Bacillus A	×	×		×		×											
" B	×	×	×	×	×				×	×	×	×	×				
" C	×	×	×	×	×	×	×	×	×	×	×	×	×			×	×
" D	×	×	×														
" E			×											×			
" F	×		×														
" H		×													×		
" K	×														×		
" L																×	
" M		×			×	×		×									
" N		×															
" O										×							
" P															×		
" Q													×				
" R									×								
" S	×	×								×							
" T				×													
Micrococcus U	×		×	×						×	×		×				

* Taken from the original communication.

TABLE II.

Showing the distribution of the bacteria.

BACTERIA.	CHOLERA INFANTUM.				CATARRHAL ENTERITIS.							DYSENTERY.		
	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.	XXVI.	XXVII.	XXVIII.	XXIX.	XXX.	XXXI.	XXXII.	XXXIII.
Proteus vulgaris	×	×		×										
Bacillus A		×												
" *a*	×		×	×								×		
" *b*					×									
Bacterium lactis aërogenes	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Bacillus *c*		×												
Bacterium coli commune	×	×		×	×		×	×	×	×				
Bacillus *d*		×	×			×								
" *e*												×	×	
" *f*		×									×			
" *g*						×								
" *h*														×
" *k*	×	×						×						
" *m*														×
" *n*										×				
" *o*	×													
" *p*	×													
" *q*		×												
" *s*	×													

eight-days' milk culture injected into the duodenum. A short circular contraction followed immediately and was limited to the point of puncture. In a few seconds wave or rhythmic contractions began just below the puncture and extended down to the ileum. In five minutes circular contractions commenced below the puncture and extended down the duodenum. A similar injection into the ileum caused active rhythmic and circular contractions over the whole small intestine, but the circular contractions were not as powerful as when injected into the duodenum.

The stomachs of the animals contained some food; the small intestine empty.

Injection into the peritoneal cavity.—2 c.c. of a fourteen-days' bouillon culture injected into the peritoneal cavity of a half-grown rabbit at 2 P.M. Found dead at 10 A.M. the following day. Autopsy: Peritoneal cavity contained a quantity of bloody serum in which cover-slip preparation showed a large number of organisms resembling the original. Nothing abnormal noticed in the different organs.

Injection into the ear-veins of rabbits.—0.5 c.c. of a sixteen-days' bouillon culture injected at 1.30 P.M. In thirty minutes after the injection the rabbit appeared to be sick, and in a short time a contraction of the upper part of the abdomen was noticed, which was followed by a copious pulpy discharge from the bowels.

Found dead at 10 A.M. the following day. Autopsy: Small intestine hyperæmic in places, especially the ileum; other parts were pale. Peyer's patches were prominent. Cœcum contained a large quantity of semifluid mass; colon nearly empty.

Esmarch tubes made from the spleen were thick with liquefying colonies resembling the original. Tubes from the blood in the heart, liver, and kidneys also contained similar liquefying colonies, but the colonies were not so thick as those from the spleen.

Diarrhœa did not occur in all the rabbits tested, but in other respects the symptoms were alike.

Milk cultures fed to young rabbits.—Milk cultures from one to three weeks old, sprinkled over cabbage and fed to young rabbits, resulted in death in sixteen to twenty hours. In some cases diarrhœa was present, but this was not constant. Cultures made from different organs as soon after death as possible were negative, except for the liver, which contained a large number of organisms resembling the original. The liver was soft and contained a large quantity of blood.

BACILLUS *a*.

Found in large quantity in three cases of cholera infantum and as the predominating form in one fatal case of dysentery.

Morphology.—In fresh gelatin colonies, small, narrow bacilli with rounded ends 1–2 μ long and 0.5 μ wide. On potato two days in the thermostat the bacilli are longer and many long filaments are seen.

Growth in colonies.—Gelatin: When small, and before liquefaction commences, the colonies have a brownish-yellow appearance under the microscope. As they grow larger liquefaction sets in, when they appear white and cloudy to the naked eye, and under the microscope yellow or brownish-yellow and uniformly granular, not lumpy. The borders of the colonies are thick, especially the dependent part.

Agar: The colonies are white, round, large, and somewhat dome-shaped. Slightly magnified, they are grayish-brown, granular, and with ill-defined concentric rings.

Stab cultures.—Gelatin: Liquefaction takes place along the line of inoculation in trumpet shape. Liquefaction is rapid, requiring only a few days to liquefy the whole tube.

Agar: The surface growth is thick, luxuriant, and light brown in color. In the depth along the line of inoculation is a well-developed stalk.

Potato: When kept twenty-four hours in the thermostat the culture is luxuriant, moist, light-yellow color, raised surface, and has well-defined borders. Later, the color changes to pinkish-yellow with glistening surface.

Temperature. It develops better at 38° C. than at a much lower temperature.

Action on milk.—Produces a gelatinous coagulation of milk in two days at 38° C. A thin layer of clear fluid soon appears on the top of the coagulum, which gradually increases at the expense of the latter until nearly the whole of the coagulum is liquefied. A brownish fluid on top and a cream-colored sediment at the bottom.

Milk litmus reaction.—Milk colored blue with litmus becomes a faded blue or fawn color in twenty-four hours at 38° C., and in three days a cream color. In some cultures two layers appear when the coagulum first forms: an upper layer, about one-fourth of the clot being a light fawn color, and a lower layer having a darker color.

Gas production.—In milk cultures fine thread-like canals appear along the sides of the coagulum, and small gas-bubbles are seen passing along the canals to the surface. Sometimes the canals are so close together and fine as to give a worm-eaten appearance to the upper part of the clot. No gas-bubbles have been seen on potato cultures.

Spores have not been observed.

Motility.—Has a motion of its own.

Resemblance.—This variety corresponds in morphology and character of growth with bacillus O, found frequently by Sternberg in the fæces of patients affected with yellow fever.

Pathogenic properties.—2 c.c. of a liquefied gelatin culture three weeks old, injected into the duodenum of young rabbits after the abdominal cavity had been opened, in a bath of normal salt solution at 38° C., according to Sanders-Ezn's method, produced rhythmic and circular contractions. A short circular contraction occurred immediately and was confined to the point of puncture. In a few seconds the intestine was quiet, then the rhythmic contractions commenced just below the point of puncture and gradually extended down the canal, reaching the jejunum in five minutes. At this time the circular contractions began in the duodenum and grew in intensity for twenty to twenty-five minutes. The circular contractions were very strong, sometimes obliterating the lumen of the canal, and were accompanied with a twisting motion. The fluid which distended the duodenum was moved down the canal by these contractions. The contractions lasted about forty minutes in the duodenum and jejunum and then commenced in the ileum. In the latter region they were very weak and were chiefly the rhythmic contraction. No movements were noticed below the ileo-cæcal valve.

One c.c. of a twelve-days' bouillon culture injected into the ear-veins of rabbits resulted in death in one and a half to two and a half hours. Violent convulsions with a number of loud cries preceded death. Autopsy: The liver contained a large quantity of blood which flowed from it after puncture almost as freely as from the heart. Esmarch tubes from the liver, spleen, and blood of the heart cavity contained liquefying colonies identical with the original.

BACILLUS *b*.

Found in one case of serious gastro-enteric catarrh.

Morphology.—Narrow bacilli with rounded ends 1–1.5 μ long .5 μ wide; sometimes they have clear places at the ends or along the sides.

Growth in colonies.—Gelatin: Colonies, when small, have a dark centre with a yellow border. As they grow larger liquefaction sets in, when they have a uniform brownish-yellow, granular appearance. Colonies do not develop well on sugar or acid gelatin.

Agar: Colonies are large, bluish-white, and spread out; slightly magnified, they have a light brownish-yellow color.

Stab cultures.—Gelatin: Liquefaction proceeds uniformly from the surface.

Agar: White, moist growth on the surface with a delicate stalk along the line of inoculation in the depth.

On potato.—The culture has a dirty brown color with a dry and but slightly raised surface.

Action on milk.—But little change noticed in twenty-four hours at 38° C.; in two days it becomes gelatinous. Milk colored blue with litmus becomes a faded blue in two days, with a thin dark-blue fluid on top.

Gas production.—Not observed.

Motility.—Actively motile.

BACILLUS *c*.

Found in one case of cholera infantum.

Morphology.—Resembles bacterium lactis aërogenes.

Growth in colonies and stab cultures.—Stab cultures and colony growth in gelatin and agar resemble bacterium lactis aërogenes.

Potato: The culture on potato also resembles that of bacterium lactis aërogenes, but it is more luxuriant and the surface is more thickly covered with gas-bubbles.

Action on milk.—Milk remains apparently unchanged and is not coagulated.

Litmus reaction.—Milk colored blue with litmus is changed in seventy-four hours, at 38° C., to a light purple, and holds this color for a number of days, when it gradually becomes reduced to a dirty cream color. Slightly acid gelatin colored light red with litmus is changed to blue.

Spores have not been observed.

Gas production.—Active production of gas-bubbles on potato; not observed in milk.

Relation to gelatin.—Does not liquefy gelatin.

Resemblance.—Closely resembles bacterium lactis aërogenes, but differs from it in not coagulating milk and in its litmus reaction.

BACILLUS *d.*

Found in two cases of cholera infantum and the predominating form in one serious case of catarrhal enteritis.

Morphology.—Resembles bacterium coli commune.

Growth in colonies.—Gelatin: Colonies grow luxuriantly in gelatin, and thrive in acid and sugar gelatin equally as well as in neutral gelatin. In the latter the colonies closely resemble, but are not identical with, the bacterium coli commune. In acid gelatin they differ very much from bacterium coli commune. The colonies spread extensively, and are bluish-white with concentric rings. Slightly magnified, they have a large, uniform, yellow central zone surrounded by a border composed of perpendicular threads placed thickly together. Sometimes a series of these rings appear with intervening yellow rings.

Agar: The colonies are round, spread out, and blue or bluish-white. Slightly magnified, they have a pale yellow color.

Stab cultures.—Gelatin: In sugar gelatin the surface growth has a nearly colorless centre surrounded by a thick border with an outer edge of fine hair-like fringe; the growth along the line of inoculation is fine and delicate. In neutral gelatin the growth is not so luxuriant as on sugar gelatin; on the surface it is thick and white with a delicate stalk in the depth.

Agar: Thick white surface growth with a well-developed stalk in the depth.

Potato: Luxuriant yellow, glistening, moist, and slightly-raised surface, with well-defined borders.

Action on milk.—Coagulated into a gelatinous coagulum in twenty-four hours at 38° C., and into a solid clot in two days.

Milk litmus reaction.—Milk colored blue with litmus is changed to light pink in twenty-four hours at 38° C. The pink color gradually fades, and by the second or third day is white or cream color with a thin layer of pink on top. The pink color extends in a few days about one-half down the clot.

Temperature.—Grows better about 38° C.

Spores have not been observed.

Gas production.—Gas-bubbles are produced in milk; not observed on potato.

Relation to gelatin.—Does not liquefy gelatin.

BACILLUS *e*.

Found as the predominating form in two cases of dysentery, one of which was fatal and the other a mild case.

Morphology.—Resembles bacterium coli commune.

Growth in colonies.—Gelatin: The colony growth varies considerably with slight difference in the gelatin. In ten per cent. neutral gelatin the colonies resemble those of bacterium coli commune. On the second or third day, when the colonies have just broken through the surface and are spread out, it is impossible to distinguish one variety from the other, but as the colonies grow older a difference can generally be recognized. In sugar and acid gelatin the colonies have a clear centre with white border; slightly magnified, a uniform brown centre surrounded by a brown zone composed of fine needle-like rays perpendicular to the border. After cultivating for a few generations on acid and sugar gelatin the colonies cease to develop, and either grow in very small colonies or do not grow at all. The activity is regained if cultivated on neutral gelatin.

Agar: Colonies are large, round, and have a mother-of-pearl appearance. Slightly magnified, a uniform yellow color.

Stab cultures.—Agar: Luxuriant, nearly colorless, surface growth with well-developed stalk along the line of inoculation in the depth.

Potato: Golden yellow, glistening, slightly-raised surface with defined borders.

Action on milk.—Milk becomes gelatinous in twenty-four hours at 38° C., and in a few days a solid coagulum is formed. Milk colored blue with litmus is reduced to white or cream color in twenty-four to forty-eight hours at 38° C., with a thin layer of pink at the top of the culture. The pink color gradually extends lower in the coagulum.

Temperature.—Thrives best at about 38° C.

Spores have not been observed.

Gas production.—Occurs in milk, but not seen in potato cultures.

Relation to gelatin.—Does not liquefy gelatin.

Resemblance.—Resembles bacterium coli commune and bacillus *d;* differing from the former in the character of the colony growth on acid and sugar gelatin and in ceasing to develop in these media after several generations. It differs from bacillus *d* in this latter respect.

BACILLUS *f.*

Found in one case of cholera infantum and one case of catarrhal enteritis.

Morphology.—Resembles bacterium coli commune.

Growth in colonies.—Gelatin: It is difficult to distinguish the colony growth from the bacterium coli commune. There is often a difference in the colonies planted at the same time and kept under similar conditions, but it is not very marked nor always the same kind of difference. The tendency to concentric rings is greater in this variety. The colonies develop somewhat better on neutral and sugar gelatin than on acid gelatin.

Agar: The colonies are large, round, and bluish-white. Slightly magnified, a light yellow color.

Stab cultures.—Gelatin: The culture is spread over the surface and has a mist-like appearance; in the depth along the line of inoculation is a delicate stalk.

Agar: Thick, luxuriant, white surface growth with a well-developed stalk along the line of inoculation in the depth.

Potato: Bright yellow, glistening, moist surface with well-defined borders and but slightly raised above the surrounding potato.

Action on milk and litmus reaction.—Milk is coagulated into a solid clot in twenty-four hours at 38° C. Milk colored blue with litmus is changed to pink in twenty-four hours at 38° C., and in forty-eight hours is reduced to white or cream color with a thin pink layer on top.

Gas production.—Gas-bubbles arise in milk cultures, but they have not been observed on potato cultures.

Temperature.—Grows better at 38° C.

Spores have not been observed.

Relation to gelatin.—Does not liquefy gelatin.

Resemblance.—It closely resembles bacterium coli commune and Brieger's bacillus in the character of its growth upon different media, but is readily distinguished from both, as is also Brieger's bacillus from the bacterium coli commune by the following differential test recently made known by Dr. Mall. Yellow elastic tissue from the ligamentum nuchæ of an ox is cut into fine bits and placed in test-tubes containing water with ten per cent. bouillon and one per cent. sugar, and sterilized from one and a half to two hours at a time for three consecutive days. Into this is inoculated two species of bacteria, one of which is the bacterium under observation, the other a bacillus found in garden earth and tetinous wounds. The latter bacillus is anaërobic, grows in hydrogen, nitrogen, and ordinary illuminating gas, in the bottom of bouillon, in the depth, but not on the surface, of agar stab cultures, and not at all in gelatin stab cultures. It has a spore in one end making a knob bacillus. Different species of bacteria—streptococcus Indicus, tetragenus, cholera, swine plague, bacterium lactis aërogenes, bacterium coli commune, Brieger's bacillus, and a number of varieties of bacteria which I have isolated from the fæces—were inoculated with the head bacillus into the above-described elastic-tissue tubes. The tubes inoculated with Brieger's bacillus developed a beautiful purple tint, which started as a narrow ring at the top of the culture, gradually extending downward and deepening in color until the whole tube had a dark purple color. This color reaction began in five to fourteen days and was constantly present in a large number of tests. Tubes inoculated with bacillus *f* gave a much fainter purple color, which was longer in appearing and never became so dark as with Brieger's bacillus.

Tubes inoculated with the other species of bacteria above mentioned gave no color change and remained similar to control. Bacillus *f* also shows a slight difference from bacterium coli commune in coagulating milk and reducing litmus more rapidly, and appears to produce more active fermentation in milk. Like Brieger's bacillus, the gelatin colonies more frequently show a concentric arrangement than those of the bacterium coli commune.

BACILLUS *g*.

Found in one case of serious gastro-enteric catarrh. It was not in large quantity.

Morphology and biological characters.—In morphology, character of growth on agar, gelatin, and potato it resembles bacterium coli commune.

Action on milk and litmus reaction.—Milk is not coagulated, and milk colored blue with litmus is changed to pink in a few days and holds this color. These characteristics distinguish it from the bacterium coli commune.

Gas production.—Not observed in milk or potato cultures.

Relation to gelatin.—Does not liquefy gelatin.

BACILLUS *h*.

Found in one case of mild dysentery, not in large quantity.

Morphology.—Resembles bacterium coli commune.

Growth in colonies.—Gelatin: In plain neutral gelatin the colonies resemble those of bacterium coli commune. In sugar gelatin the colonies are white and spread extensively. Slightly magnified, they have a round, dark centre surrounded by a yellow, loose zone with an outer white rim; later, the whole colony has a uniform yellow color and is not compact.

Agar: Colonies are white, round, and large. Slightly magnified, they are brownish-yellow.

Stab cultures.—Nothing characteristic in gelatin and agar.

Potato culture is yellow, dry, and slightly raised, with well-defined borders.

Action on milk and litmus reaction.—Milk is coagulated into a solid clot in two days at 38° C. Milk colored blue with litmus is changed to pink in twenty-four hours.

Gas production.—Occurs in milk; not observed on potato.

Relation to gelatin.—Does not liquefy gelatin.

BACILLUS *k*.

Found in two cases of cholera infantum and one of catarrhal enteritis.

Morphology.—Resembles bacterium coli commune.

Growth in colonies.—Gelatin: In neutral gelatin the colonies cannot be distinguished from those of bacterium coli commune. In acid gelatin the colonies do not spread so extensively as those of bacterium coli commune, and they have a decided concentric arrangement, a wide white centre surrounded by a narrow transparent blue ring, and outside of this a white border. Slightly magnified, the colonies have an irregular yellowish-brown centre mottled over with dark spots and surrounded by a light yellow ring bordered by a brownish-yellow wreath.

Agar: Colonies are large, round, and bluish-white. Slightly magnified, a light brownish-yellow color.

Stab cultures.—Gelatin: In sugar gelatin the surface growth is extensive, nearly colorless, and has a rough, misty appearance. In the depth is a delicate growth. In plain neutral gelatin the surface growth is bluish-white, thick, and not so extensively spread; the growth in the depth is also thicker.

Potato culture is moist, dirty cream color, has raised surface and defined border.

Action on milk.—Milk becomes gelatinous in twenty-four hours at 38° C., and a solid clot in two days. Milk colored blue with litmus is changed to pink in twenty-four hours and reduced to white with a pink layer on top in two days.

BACILLUS *m*.

Found the predominating form in one case of mild dysentery.

Morphology.—Resembles bacterium coli commune.

Growth in colonies.—Colony growth in gelatin and agar closely resembles that of bacterium coli commune. Stab cultures are also similar.

Action on milk and litmus reaction.—Milk is not coagulated and remains apparently unchanged. Milk colored blue with litmus is not changed in color to any extent. In old cultures the color fades a little, but is not changed from blue.

Gas production.—Not observed in milk or potato cultures.

Relation to gelatin.—Does not liquefy gelatin.

Spores have not been noticed.

Resemblance.—Closely resembles bacterium coli commune in many respects, but is distinguished from it in not coagulating milk or reducing litmus.

BACILLUS *n*.

Found in large quantity, but not the predominating form, in one case of chronic gastro-enteric catarrh extremely emaciated.

Morphology.—Resembles bacterium coli commune.

Growth in colonies.—Gelatin: In neutral gelatin the colonies are spread out and have a frosty or ground-glass appearance. The centre is blue and border white, but both have the ground-glass appearance. Slightly magnified, the central part is light yellow and the border brown with a rough, furrowed surface. In acid gelatin the white border is wider and the surface is rougher.

Agar: Colonies are round, blue, or bluish-white, and spread out. Under the microscope they have a light yellow color.

Stab cultures.—Gelatin: Has a rough, nearly colorless, surface growth and a thick stalk in the depth along the line of inoculation.

Agar: Thick white surface growth with well-developed stalk in the depth.

Action on milk and litmus reaction.—Milk remains liquid, and milk colored blue with litmus is changed to pink.

Gas production.—Not observed in milk or potato cultures.

Relation to gelatin.—Does not liquefy gelatin.

Spores have not been noticed.

BACILLUS *O.*

Found in one case of cholera infantum.

Morphology.—Small, short bacteria.

Growth in colonies.—Gelatin: Colonies are bluish or nearly colorless; sometimes with a clear blue centre and frosty border. Slightly magnified, they have a straw or light yellow color with a rough surface and sometimes a wheel-like appearance in the centre. The colonies do not spread much. In two to three weeks the colonies liquefy and the gelatin runs down in a thick, cloudy fluid. Liquefaction is always slow, and there is no evidence of it before the second or third week.

Agar: Colonies are large, round, and bluish-white. Under the microscope, a uniform straw color.

Stab cultures.—Gelatin: There is a similar slow liquefaction as in the colonies. The surface growth is thick and rough; along the line of inoculation in the depth is a well-developed stalk.

Potato: The culture is dry, yellow with raised surface and defined borders.

Action on milk and litmus reaction.—Milk becomes gelatinous in two days at 38° C.; in one or two weeks, a solid coagulum. Milk colored blue with litmus is changed to pink in twenty-four hours; this color gradually fades and is completely reduced in one to two weeks.

Gas production.—Occurs in milk, but not observed in potato.

Spores have not been observed.

BACILLUS *p*.

Found in one case of cholera infantum.

Morphology.—Small, short bacilli; when joined in twos they have the appearance of diplococci with pointed ends.

Growth in colonies.—Gelatin: The colonies are small, but slightly spread out and nearly colorless. Slightly magnified, the surface colonies are brownish-yellow and granular. In acid gelatin the colonies are very small and coarsely granular.

Agar: The colonies are small, white, round, and spread out. Slightly magnified, they are uniformly pale yellow or straw color.

Stab cultures.—In gelatin the growth on the surface and in the depth is delicate and not luxuriant.

In agar stab cultures the growth is more flourishing in the depth along the line of inoculation, but has a very slight surface growth.

Potato: Moist, glistening, straw-colored surface growth.

Action on milk.—Milk is coagulated with evolution of gas in forty-eight hours at 38° C. Milk colored blue with litmus is reduced to white in twenty-four hours, with a pink skim on top; the pink color gradually extends to about one-fourth down the coagulum.

Relation to gelatin.—Does not liquefy gelatin.

BACILLUS *q*.

Found in one case of cholera infantum.

Morphology.—Very small bacteria, sometimes showing the polar staining.

Growth in colonies.—Gelatin: Colonies are not large, and nearly colorless. Slightly magnified, they have a pale straw color with small round nucleus in the centre. Some colonies have a large, round, yellow central part laid on a white border, giving the appearance of a colony being placed on one a little larger and showing only the rim of the latter. In acid gelatin the colonies are very small.

Agar: Colonies are large, round, bluish-white, or have a mother-of-pearl appearance. Slightly magnified, they have a brownish-yellow color.

Stab cultures.—Gelatin : Raised, bluish-white, rough surface growth with a luxuriant growth along the line of inoculation in the depth.

Agar: Luxuriant, moist, white surface growth with well-developed stalk.

Potato: Culture spread extensively over the surface, is straw color or brownish-yellow, and dry; surface not raised above the surrounding potato.

Action on milk.—No perceptible change in milk, and milk colored blue with litmus becomes a deeper blue than the control.

Gas production.—Not observed in milk or potato cultures.

Relation to gelatin.—Does not liquefy gelatin.

Spores have not been observed.

BACILLUS *s.*

Found in one case of cholera infantum.

Morphology.—Small bacilli with rounded ends. In agar, twenty-four hours in the thermostat, many long threads, composed of jointed rods, are seen.

Growth in colonies.—Gelatin: Colonies are white, moderately thick, and spread but little. Slightly magnified, they are for the first few days uniform straw color; later, the colonies become lobulated. The lobulated appearance commences in the centre and extends over the whole colony. The color also changes to dark yellow.

Agar: Colonies are white and round. Slightly magnified, they have a light brown color, are not compact, and the borders not well defined.

Stab cultures.—Gelatin: Thick white surface growth with well-developed stalk along the line of inoculation in the depth. As the culture grows older it becomes purple; the purple color diffuses a short distance in the upper layer of gelatin just under the surface growth and immediately surrounding the growth in the depth.

Agar: The growth on the surface and in the depth is luxuriant and gives a brown color to the whole tube.

Potato: The culture has a brownish color, dry and raised surface, with defined borders.

Action on milk and litmus reaction.—No perceptible change is produced in milk, and milk colored blue with litmus changes but little, if any, from the control.

Gas production.—Not noticed in milk or potato cultures.

Relation to gelatin.—Does not liquefy gelatin.

Spores have not been observed.

GENERAL CONSIDERATIONS.

With the sixteen cases reported in the first communication, bacteria have been isolated from the fæces of thirty infants affected with summer diarrhœa, eleven of whom had cholera infantum, fourteen catarrhal enteritis, and five dysentery.

It is not to be supposed that all of the species of bacteria contained in the fæces of each case, and which are capable of growing even upon our present nutritive media, have been separated. The disadvantage of being restricted through atmospheric heat for the greater part of the summer to agar-agar as a separating medium greatly increases the difficulty of separating bacteria. Colonies do not differentiate so widely in agar as in gelatin, especially bacteria which liquefy gelatin. Liquefying colonies are readily distinguished when a colony of the same bacterium in a mixed agar tube may show nothing distinctive.

In the first sixteen cases, consisting of seven of cholera infantum, six catarrhal enteritis, two dysentery, and one simple diarrhœa, agar was the exclusive medium for separating bacteria. Varieties of bacteria which liquefy gelatin were found in only five of these cases.

In the fourteen cases furnishing the material for this article, and consisting of four cases of cholera infantum, seven catarrhal enteritis, and three dysentery, gelatin was used in addition to agar in ten cases, and bacteria which liquefy gelatin were found in seven of these. Liquefying bacteria are thus found more frequently when gelatin is used as a separating medium, and it is probable that if it had been used in all of the cases, liquefiers would have been found more common.

The cases in which liquefying bacteria were found were more serious than those in which they were not found.

By reference to the tables showing the distribution of the bacteria in the different cases, it will be seen that, with the exception of bacterium lactis aërogenes and bacterium coli commune, the two constant or obligatory milk-fæces bacteria, no species of bacteria appear with much constancy, taking the cases as a whole.

If the different forms of diarrhœa are considered separately, in the cases classed under the head of cholera infantum, one group of bacteria—the proteus group—appears in seven of the eleven cases examined. In the four cases in which no member of this group was found, agar was used exclusively as the separating medium in three cases, and in the other case a number of cultures were lost before being identified. Not being isolated in these cases does not necessarily indicate an absence from the fæces.

During the past summer (1889) bacteria were isolated from the fæces of thirteen children, eight of whom had cholera infantum and five catarrhal enteritis. While the differentiation of all the cultures in these cases has not been sufficiently worked out to incorporate in this report, the proteus bacteria have been identified with certainty in the eight cases of cholera infantum. The addition of these eight cases makes a total of nineteen cases of cholera infantum in which bacteria have been isolated from the fæces, and in fifteen of the cases one or more members of the proteus group of bacteria have been found.

The proteus group is composed of varieties of bacteria having certain peculiarities in common. They have a varying morphology; in gelatin the colonies swim along the surface, producing many different and curious forms, and all of the varieties of bacteria composing this group possess the property of causing putrefaction in albuminous compounds.

Hauser has made a careful study of the proteus group of bacteria, and describes three varieties—viz., proteus, vulgaris, and mirabilis—which liquefy gelatin and blood serum, giving off a specific unpleasant, somewhat putrefactive, cheesy odor, and proteus Zenkeri, which does not liquefy gelatin or blood serum.

The proteus bacteria do not grow in the so-called normal solution and seem to require highly-organic compounds. They are facultative anaërobic, and live in pure carbonic acid.

It is not easy to examine meat entering into putrefaction without finding one or other variety of this group of bacteria, especially proteus vulgaris and mirabilis, which are often found together. Proteus bacteria are found in different putrefactive animal substances, such as putrefactive anatomical preparations, bone maceration, water, ichorous discharges of ulcers, carcinomatous ulcers, etc.

Not only do the proteus bacteria possess in a high degree the power to excite putrefaction, but, on account of their extension and frequent occurrence, they belong to the most important and ordinary exciters of putrefaction.

In consideration of the almost constant occurrence of the proteus group of bacteria in ichorous discharges of all kinds, and as this has poisonous properties for the animal organism, it is probable that this species of bacteria is of essential importance for the etiology of a class of cases of septicæmia.

In spite of the wide-spread and frequent occurrence of this group of bacteria in the most manifold decomposing animal tissues, they were not found as an accidental impurity in other bacteriological investigations made by Hauser. He also failed to find them in air when gelatin was exposed in the neighborhood of putrefaction. Hauser thinks this may mean that the proteus bacteria lose their germ activity in a completely dried condition, and in dried dust proportionately few vitally active germs are present.

The prominent symptoms of the cases of cholera infantum in which the proteus bacteria were found were drowsiness, stupor, emaciation or great reduction in flesh, more or less collapse, frequent vomiting and purging, with watery and generally offensive stools.

Proteus vulgaris was found in the largest number of cases; bacillus A was also frequently found.

Experiments upon lower animals with proteus vulgaris and bacillus A gave about the same results.

Bouillon cultures injected into the veins of rabbits caused death in a few hours. There was drowsiness and stupor and finally convulsions in all the animals, and in some diarrhœa, the latter very profuse in two cases.

Cultures injected directly into the intestines of rabbits, when exposed by Sanders-Ezn's method, produced active peristalsis.

Cultures fed to young animals resulted generally in death, and in some diarrhœa occurred.

The frequent occurrence of this widely-spread group of putrefactive bacteria in the most serious cases of summer diarrhœa, in which toxic symptoms are more or less prominent, cannot be without significance.

With one exception, in cases of diarrhœa free from toxic symptoms no member of this group of bacteria has been observed, nor were they found by Escherich in the healthy fæces of sucklings.

Another species of bacteria which liquefies gelatin—bacillus *a*—was found in large quantity in three cases of cholera infantum and one fatal case of dysentery. In two of the cases of cholera infantum proteus vulgaris was also found. These two cases were especially grave and had decided stupor, one for two days, the other seven days.

Bacillus *a*, like the proteus bacteria, was not observed in any of the milder cases of diarrhœa. It liquefies gelatin rapidly and appears identical with a bacillus found by Sternberg quite frequently in the fæces of yellow fever patients in the recent epidemic of this disease in Decatur, Alabama.

In experiments upon rabbits with bacillus *a*, death occurred in a few hours when injected into the ear-vein, being preceded by drowsiness and stupor and finally convulsions. When injected directly into the intestine by Sanders-Ezn's method active peristalsis was produced.

No variety of bacteria appeared to be especially associated with the cases of catarrhal enteritis and dysentery.

The fæces in catarrhal enteritis often contain an enormous quantity of bacteria, chiefly varieties of colon bacteria and bacterium lactis aërogenes with a number of inconstant varieties. Some of these bacteria have a decided action on milk, producing coagulation with evolution of gas; others appear to peptonize milk without coagulating it.

Bacteria which liquefy gelatin were found in only a few of these cases, and no liquefying variety was observed in more than one case.

The two obligatory milk-fæces bacteria do not appear so constantly in the dysenteric as in the diarrhœal fæces. Bacterium lactis aërogenes was found in three cases, and a supposed variety of the colon bacteria appeared as the predominating form in two cases. The dysenteric discharges do not contain as great a number of varieties or of individual bacteria as the diarrhœal fæces.

A comparison of the tables shows that the inconstant bacteria not only vary in different cases. but also with different summers. The bacteria in Table I. were separated in the summers of 1886 and 1877. These bacteria do not appear among the bacteria in Table II., which were separated in the summer of 1888.

No chromogenic bacteria have been isolated. Esmarch tubes, made from a large number of green stools, developed no green colonies.

In conclusion, it must be understood that this work is too incomplete to admit of positive conclusions, and that it refers to the examination of but a limited number of cases in which not even all the bacteria capable of being cultivated on our present nutritive media are supposed to have been separated, and those separated have been but imperfectly studied.

ANEURISM IN EARLY LIFE.*

BY A. JACOBI, M.D.,
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THE following history of *aneurism of the abdominal aorta*, occurring in a girl of five years, was furnished me by Charles F. C. Lehlbach, M.D., of Newark, N.J. I cannot do better than copy it in full in his own words:

"The patient from whom the specimen was taken died in Dr. E. J. Ill's private hospital, at Newark, N.J., July 8, 1887, of acute tubercular meningitis, at the age of five years and three months.

"*Parental history.*—Her parents were both dead. Her mother had died, October 13, 1885, at the age of thirty years, of pulmonary phthisis, probably tubercular, after a succession

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* Read by title.

of preceding illnesses covering a period of sixteen months,—namely, measles, subacute bronchial catarrh, an intercurrent abdominal typhoid fever, of severe type, with intestinal hemorrhages, followed by chronic interstitial pneumonia, with undoubtedly final tubercular infiltration. She was a woman of delicate build and poor nutrition, though her parents are yet both living.

"The father—a physician in very active practice—died at the age of thirty-six years, five months later (February 27, 1886), of acute tubercular meningitis, nine days after a first initiatory general convulsion, followed by delirium and coma. His general health had been poor on account of overwork in practice and domestic cares, caused by the sickness of his wife. During the preceding year he had been troubled more or less with attacks of arthritis, mainly in the right wrist and elbow, supposed to be rheumatic, but probably tubercular. His only previous illness of any importance had been right-sided pleurisy, eight years before, resulting in adhesions, without crippling the lung seriously. Beside the tubercular meningitis, which the autopsy showed, moderate tubercular infiltration, particularly of the right apex, was also found. His parents had both died within the preceding three years,—the father of heart-failure (chronic valvular disease and hypertrophy), the mother of cerebral apoplexy (fulminant).

"*Patient's history.*—With the exception of pertussis and measles, which the patient had successively gone through with in the winter of 1883–84, and from which she fully recovered, although of slight build and delicate osseous and muscular development, nothing pathological occurred in her history until the latter part of the summer (August and September, 1886), six months after the death of her father, while spending a season with the family of her aunt at the sea-shore.

"On one occasion, after running and jumping, she suddenly complained of severe pain in the right leg, which, being looked upon as caused by a sprain, was treated by rest and liniments. She recovered from the effects of this, apparently, in a few weeks. But later on, after the family's return home, she was noticed occasionally to limp and to complain of pain in the leg. At this time no shortening or change of position of the limb was apparent; but it was thought best to keep her at perfect rest in bed, and later, in November and December, she was placed in extension. Examination under full anæsthesia failed to disclose positive evidence of destructive hip-joint disease.

"As the little patient became very restless in bed, and the pain had markedly subsided, it was thought proper to give a trial by allowing her to sit up in easy-chairs, after removing the extension. A few weeks' freedom, limited, however, to sitting up in the room, was followed by some increase of pain, slight eversion of the limb, with apparent shortening, and a certain amount of puffiness of the hip-joint. She was then placed a second time in a permanent recumbent position with extension, and while under anæsthesia, manipulation of the limb showed neither crepitation nor roughness of the articulating surfaces.

"She remained in the extension apparatus, with counter-irritation around the joint, roborating treatment, and good diet, until some time in April, when shortening and eversion became more marked, when the weights were temporarily removed, and the question of excision of the joint came up.

"Dr. A. Jacobi was called in consultation, the patient once more placed under an anæsthetic, and this time, on rotating and pushing the femur up towards the acetabulum, distinct crepitation was detected, leaving no longer any doubt of the existence of destructive coxitis. It must be remarked here that no marked elevation of temperature had been observed during the progress of the disease.

"Excision of the joint having been decided upon, as giving the patient the only chance for an approximately useful limb, and perhaps life, the operation was performed by Dr. E. J. Ill, of Newark, in his private hospital, April 23, 1887. The destruction of bone was much further advanced than had been suspected. All of the head of the femur had been destroyed, with the neck and the larger trochanter; there was little pus; the acetabular surface in its greater extent was smooth and healthy, and only towards the lower and outer border felt roughened; the roughness, however, was fibrous, and not that of necrotic or carious bone. After removal of all of the diseased portion of bone, the cavity left was thoroughly washed out with an antiseptic solution, packed with iodoform gauze, and she was placed once more in fixed extension.

"From this time on to within less than a week before the child's death, on July 8, 1887, the case was one of unbroken favorable progress. The shock of and reaction from the operation were almost *nil.* There was very little rise of temperature during the first two days, and none subsequently; what little secretion the wound cavity showed at the various dressings was inodorous, and healthy granulations soon commenced to fill up the acetabular bottom of the wound, the end of the femur became covered by smooth granulations, so that at the end of eight weeks, the wound having almost closed, the little patient, when the weights were removed, took delight in showing how she could move the leg. She was moderately encouraged in this in order to induce the quicker formation of a serviceable artificial joint.

"About five days before death she commenced to complain of severe pain in the left epigastric region, of a colicky character, and intermittent; there was no rise of temperature, and the bowels were freely open. On deep palpation an indefinite tumescence could be felt in the left epigastrium, with more or less distinctness, at various examinations.

"This state of things continued up to forty-eight hours before death, when, suddenly, without any premonitory symptoms of cerebral trouble, she was seized with general convulsions, lasting from ten to fifteen minutes, from which she recovered gradually to complete consciousness, but complaining of much headache. This was followed by rise of temperature the next day, and the recurrence of four more convulsions up to the time of death, with increasing headache during the intervals, the last convulsion being quickly followed by coma and death. The urine had been normal.

"*Autopsy* made by Dr. E. J. Ill in my presence.

"There being, in our opinion, no doubt whatever that the cause of death was tubercular meningitis, the brain, under the peculiar circumstances surrounding the case, was not examined. The main object was to inspect the reparative process in the joint, to examine the lungs and heart, and to find, if possible, an explanation of the tumescence in the left epigastrium, the seat of the severe pain before the occurrence of the fatal convulsions.

"The reparative process in the joint had been remarkably complete. The acetabular cavity had filled up completely, the femoral covering smooth, and the formation of an artificial joint with good socket was certainly only a matter of time had the patient lived.

"The heart was found healthy, free from endocardial or valvular lesions.

"The apices of both lungs presented several areas of disseminated miliary tubercles.

"On removing the abdominal integuments and the overlying intestines, a tumor was readily felt and seen at a point corresponding to the tumescence, noticeable on deep palpation during life, and, on its removal, it was found to be *aneurismal, involving the abdominal aorta.*

"Circumstances did not permit any further and more minute examination."

From a letter of Dr. Lehlbach's, dated October 9, 1888, I quote the following remarks:

"There is hardly a doubt as to the nature of the hip-disease of the little patient. It was certainly tubercular, for there were tubercles in the lungs also. By what road, however, bacilli entered the abdominal aorta is problematical for the present. The occurrence of parasitical (also tubercular) aneurisms has been demonstrated by Hans Eppinger in his 'Pathogenesis of Aneurisms' (Langenbeck's *Arch. Klin. Chir.*, vol. xxxv., Suppl.). But all of his observations refer to aneurisms by erosion, in the closest proximity to cavities, where the migration of bacilli took place from the pulmonary tissue into the structure of the blood-vessel. I have not succeeded in finding among the cases recorded by Eppinger a single one similar to mine, always provided that this was also of tubercular nature."

The modern literature on the subject of aneurism in the young is but scanty. In 1884 (*Med.-Chir. Trans.*, vol. lxvii.), R. W. Parker collected fifteen extracranial cases. Sanné reported from literature three cases of aneurism of the aorta and atheromatous degeneration of the aorta in the young

(*Revue Mens. des Mal. de l'Enfance*, February, 1887), and added a new one, in a girl of thirteen years. The latter, and ten more from literature, are enumerated by W. W. Keen ("Two Cases of Aneurism in Girls of Eighteen and Eight Years of Age," *Med. News*, December 24, 1887), who thus swells the number of cases of extracranial aneurisms to twenty-eight. Lehlbach's case, so graphically described by him in the above history, is the twenty-ninth. Unfortunately, the specimen has disappeared from my premises in an unaccountable manner, and I therefore fear the accurate description of the case and its histological etiology will be rendered impossible forever. Still, even so, the small number of cases thus far known constitutes this new case a welcome addition to those hitherto reported. It is more than merely possible that tubercular invasion was the primary cause of the aneurismal dilatation described above.

The cases of aneurismal dilatation may be various. In the case of Hutchinson (*Trans. Pathol. Soc. of London*, p. 104, Keen) the cause was an *abscess*. The patient was a girl of four years, who suffered from an aneurism of the arch of the aorta. No prior symptoms of aneurism. Child died, after ten days' illness, of acute pericarditis. Mr. Hutchinson believed that the aneurism originated as an abscess, and had ulcerated into the vessel. The lining membrane of the aorta was smooth and perfectly healthy up to the edges of the orifice of communication (one-fourth by one-eighth of an inch) with the sac. This was the size of two chestnuts placed side by side, and hung from the arch of the aorta into the pericardium, compressing somewhat the pulmonary artery. The heart was normal, but in the lungs were tubercles, with chalky concretions in the bronchial glands.

Another cause is *embolism*, depending on valvular disease. Of this nature was Langton and Bowlby's case (*Brit. Med. Jour.*, 1886, ii. p. 103). The patient, a girl of twenty, had ulcerous endocarditis, an aneurism of the right elbow, right popliteal, and hemiplegia. There were multiple emboli and aneurismus in brain, trunk, and extremities. Many of Parker's cases are of this character.

The third is *endarteritis*, as in Moutard-Martin's case, which occurred in a boy of two years, who had an atheromatous arch and a hypertrophied heart. Such occurrences are extremely rare. Under the heading of periarteritis nodosa, Kussmaul and R. Maier described (*Arch. f. Klin. Med.*, I. p. 484) certain multiple degenerations of the arteries. Their case was observed and examined at a time when no other cases had been treated with equal care. They took the little swellings for nodules of connective tissue, and thus came to the conclusion that they had to deal with a new form of periarteritis. Eppinger draws attention to the fact that a number of these nodules are distinctly described as being hollow, and is undoubtedly correct in ranging their case among those (few of which have been hitherto observed) of multiple aneurismal degeneration. Of the same nature was a case of P. Meyer (*Virch. Arch.*, lxxiv. p. 277) and that of Weichselbaum and Chrostek (*Allg. W. Med. Zeit.*, 1877, No. 28).

Congenital incompetency of the walls of blood-vessels is another cause of aneurismal dilatation. Voigtel insisted first on this connection, Cruveilhier described a case of cirsoid aneurism depending on congenital thinness of the tunica media, and refers to the fact that sometimes a thin artery cannot be diagnosticated from a vein. Virchow explained the most persistent and incurable cases of chlorosis by the thinness and smallness of the arteries, and met with a case of simple dilatation of the blood-vessels of the pia mater and consequent aneurism which depended on atrophy of the media. Klebs observed thin vessels in a dropsical child of thirty-two weeks, and C. O. Weber, Balassa, and Gull refer to the influence of congenital atrophy and debility of the arterial walls. Finally, the case of hereditary cerebral hemorrhage observed by Dieulafoy (*Gaz. Hebdom.*, 1877, Nos. 16 and 18) is apt to illustrate the influence of the original structures on the formation of pathological conditions.

It is to this class that belong the anatomical alterations of the elastic tissue in the walls of the arteries. Eppinger's researches are contained in a special part of his "Pathogenesis of Aneurisms," which fills entirely the 562 pages of the third and fourth fascicles of the *Arch. f. Klin. Chir.*, of 1887, and reports among many other cases the following new one:

"A girl of ten years died in 1875, in the St. Anne Children's Hospital, with the symptoms of universal marasmus. No syphilis. There were no remarkable anomalies of any organ, with the exception of the heart. It showed a very large number of aneurisms, hundreds of which—up to a width of four millim., with either large or small orifices—originated all along the walls of the right and left coronary arteries with all its very smallest ramifications. The intercostal arteries were in the same condition."

His microscopical examinations have led to very remarkable results. He found that even every nodulated thickening, or apparent thickening, of the walls of the small arteries was indeed a true aneurism. These were not always of the same description. The elastic tissue was abruptly torn, the muscular layer also more or less extensively, and the two joining each other, or rolled up into each other, in the most various ways. In the wall of an aneurism thus formed not a trace of either muscular or elastic tissue can be found. That wall consists of the thickened intima and the adventitia closely attached to it. Now and then aneurisms were found at the bifurcation of arteries, so that it consisted of both a dilatation of the artery and a branch. Almost all these aneurisms had a centrifugal development,—that is, they were developed and enlarged in the direction of the circulation. In some the muscular layer did not stop abruptly, it grew gradually thinner, and exhibited granular degeneration, but the main part of the aneurism consisted of the intima and adventitia. Whenever all of the arterial layers were intact, there never was a dilatation, but only when either the elastic or the elastic and muscular layers were absent.

This condition of things is found exclusively in the arteries of medium or of small size. In them the elastic layer consists of a uniform and thin mass; in the large arteries, however, the elastic membrane extends into the other layers. It is a noteworthy fact that the aneurisms referred to occurred mostly on bifurcations. It is here that the elastic membrane is thinnest under ordinary circumstances.

A fifth cause of aneurism is to be found in morbid *histological alterations of the blood-vessel walls.*

P. Meyer published a series of careful investigations, mostly made on the pulmonary artery (in Recklinghausen's laboratory), on "the formation and significance of hyalin in aneurisms and the blood-vessels."* That name—hyalin—was given by Recklinghausen to a substance which is believed to originate in a metamorphosis of the protoplasm of the cells. It is homogeneous, refracts the light strongly, and is mostly penetrated by a net-work of fine canaliculi, or by irregular fissures and lacunæ. It is identical with what Langhans described under the name of "canalized fibrin" in the placenta; its origin is attributed to a transformation of the white thrombus. It is true that Auerbach and others deny the existence of this substance, but Meyer claimed to have found it in a case of periarteritis nodosa.†

In order to study the aneurisms of the pulmonary artery, he made fine sections through the blood-vessels protruding into a pulmonary cavity, and examined the blood-vessels, which were not changed at all, or but little. The principal alterations were met with in the media. It was absent in the aneurismatic sac, present in the opposite wall, and gradually disappeared between the two. In the vessel the intima was hypertrophied; at the beginning of the dilatation it was covered by a thin and homogeneous layer, which showed a strong refraction of light and penetrated into the very tissue of the intima. In the convexity of the aneurism itself the whole vessel had undergone that change; the hyaline substance being perforated by a net-work of canaliculi devoid of walls. The inner layers were of a looser consistency, the lacunæ being more irregular and exhibiting thrombotic deposits. Externally, the wall of the aneurismatic sac, thus altered, exhibited a gradual transition into the caseous granulation tissue which formed the wall of the cavity.

Adopting this theory of ånatomical changes in the blood-vessel walls, as a predisposition to aneurismal dilatation, Julius Hoffnung‡ reports a case of aneurism in a branch

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* *Arch. de Physiol.*, 2me sér., vii. (4) p. 598, 1880; *Schmidt's Jahrb.*, 1883, vol. cc. p. 201. † *Virchow's Arch.*, vol. lxxiv. p. 277.

‡ "Ueber Hæmoptoë bei Kindern," Inaug. Diss., Berlin, 1885; E. Henoch, "Vorles. üb. Kind.," ed. iv., 1889, p. 412.

of the pulmonary artery in a girl of ten months, who died of hæmoptoë. The left lung adhered firmly to the costal pleura. During its removal the pulmonary pleura was torn about the middle of the lung, and a brownish-red fluid escaped. The upper lobe was solid with hepatization, the centre of which was formed by a caseous mass of the size of a hazel-nut. There was a cavity of the size of a pigeon's egg filled with the above-mentioned fluid. In that cavity there was a tumor of the size of a hazel-nut which proved to be an aneurism of a branch of the pulmonary artery; it still contained a firm parietal thrombus which clung to its wall. The lower lobe of the lung was also hepatized.

F. Rasmussen * had the care of a "very young" girl, who had pulmonary phthisis and died suddenly in an attack of hemorrhage. All the healthy bronchi were obstructed by blood. A careful section of the lung revealed a very small cavity on the boundary line between the indurated and the aërated portion of the lung. A small artery followed the bronchus leading into the cavity; on the very spot where the artery was in contact with the wall of the cavity, a small aneurism was found which was ruptured. In its interior was found a layer of an older coagulum which pressed into the rent.

The same author published the case of a boy of three and a half years who was known to be phthisical, and died suddenly of hemorrhage. The autopsy exhibited in the lungs a chronic interstitial and caseous pneumonia, peribronchitis, and miliary tubercles. There was an aneurism of a branch of the pulmonary artery which had ruptured into a cavity. There were also miliary tubercles in the pleura, spleen, liver, and kidneys.

O. Wyss† reports the case of a child of a little more than a year who was attended for diffuse capillary bronchitis with infiltration of the right apex. An emetic was administered. An attack of coughing followed the first vomiting, and with

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* Hosp. Tidende, xii., Nos. 11, 12; *Nord. Medic. Archiv*, i., No. 12; Julius Hoffnung, p. 18; Hirsch, *Virchow's Jahr.*, 1869, ii. 101.

† C. Gerhardt, *Handb. d. Kinderkr.*, iii. (2) p. 807.

it a large amount of clear red blood was discharged through both nose and mouth. Death was immediate. There was, in the right apex, a caseous "pneumonic" infiltration, in the centre of which was a cavity of the size of a walnut which communicated with a bronchus. Near by was found an aneurism of a branch of the pulmonary artery, which had ruptured into the cavity.

Ch. West,* when reporting seven cases of fatal pulmonary hemorrhage in tuberculous children, three of whom were examined after death, found the cause of the hemorrhage in one. A cavity in the lower part of the right lower lobe was traversed by a vessel on which an aneurism had formed of the size of a hazel-nut.

TWO CASES OF NYSTAGMUS ASSOCIATED WITH CHOREIC MOVEMENTS OF THE HEAD IN RACHITIC BABIES.

BY A. CAILLÉ, M.D.,

New York.

UNDER the titles spasmus nutans, nictitatio spastica, etc., several writers have reported cases of clonic spasms of a group of muscles innervated by the accessory nerve, notably the sterno-cleido mastoid, trapezius, and recti capitis muscles.

This muscular unrest may be unilateral or bilateral, and ceases during sleep.

Nothing is known as to the etiology of this condition.

In severe cases of long standing the prognosis is unfavorable, and the treatment is limited to the removal of any form of reflex irritation which may be present or is supposed to exist.

A short description of spasmus nutans may be found in some of the text-books on nervous diseases and diseases of children and in reports by Newham, Henoch, Ebert, Fournier,

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* Lectures, 7th ed. p. 531.

Demme, and others, *vide* Eulenberg's Encyclopædia article, "Spasmus Nutans," vol, xii.

As the two cases which came under my notice presented features not hitherto described, I have concluded to report them.

The first case seen by me was that of a child eleven months old, in which the choreic movements were noticed by the mother on the day following an injury to the head by falling from a high chair. The muscles supporting the head were in such a state of unrest as to seriously interfere with the comfort of the child. The child soon became peevish, refused to take food, and became emaciated in appearance.

A careful examination showed a marked rachitic development and nystagmus of the horizontal type. The eyes were examined by competent ophthalmologists,—Drs. Koller, Schapringer, and E. Fridenberg,—and, excepting nystagmus, nothing abnormal was detected.

It was furthermore noticed that if the child's attention was engaged by a shining object held at some distance above the eye-level, nystagmus and choreic movements would cease during fixation.

It was also apparent that the movements of the head were not the consequence of muscular weakness, but, on the contrary, it seemed as though they were due to a distinct effort on the part of the child for the purpose of visual fixation, made difficult by the existing nystagmus.

The application of an eye-bandage suggested itself, and as soon as this was in such a position as to exclude every ray of light the choreic movements ceased completely; if, however, the bandage was so applied as to admit but very little light the head movements persisted.

This phenomenon was observed by a number of my colleagues, and could be reproduced at any time.

Under such circumstances a permanent eye-bandage suggested itself as a therapeutic procedure. The bandage was properly applied, and removed but once a week for cleansing purposes. The child was carried to the river-side daily, and was treated to salt baths and massage. The diet was regulated and phosphorus given internally.

This treatment was faithfully carried out by the mother, and at the end of three months nystagmus and choreiform movements had ceased, and the child was plump and healthy in appearance.

In a second child the symptoms manifested themselves after an attack of measles. At the time of presentation there were moderate conjunctivitis, the nystagmus of the vertical type, and the movement of the head; treatment and ultimate good results the same as in first case.

It appears from these observations that the localized clonic muscular spasms were either compensatory to the movements of the eyeball or reflex from irritation occasioned by the light to those structures which are concerned in carrying the impression. In view of the fact that the choreic movements ceased as soon as all light was excluded from the child's eyes, I am unable to formulate a more satisfactory explanation of the phenomena observed than the one I have expressed.

DISCUSSION.

BOSTON, September 16, 1889.

W. D. BOOKER, M.D.:

Dear Sir,—I see that Dr. Caillé is to report two cases of nystagmus at the meeting of the Pediatric Society. I am sorry to say that I shall be unable to be present; but I thought that, perhaps, you might like to mention that, some years ago, I had under my care two babies, children of the same parents, their difference in age being about one and a half years.

These babies were both, so far as I could determine, perfectly healthy, as were the parents, but they both had nystagmus, with no other symptoms of disease. The nystagmus began in the dental period; lasted a number of months; in both cases recovered entirely on the completion of dentition, and under purely expectant treatment. Hoping that you may find these cases interesting in connection with Dr. Caillé's, I am

Yours, very truly,

T. M. ROTCH.

REPORT ON TWO YEARS OF EXPERIENCE IN THE MECHANICAL TREATMENT OF GASTRO-INTESTINAL DISTURBANCES IN INFANTS.

BY A. SEIBERT, M.D.,

New York.

By mechanical treatment of gastro-intestinal disorders we understand the washing out of the stomach and of the large bowel of the patient.

There is no more doubt in our minds to-day regarding the origin of these affections in infants, in so far as we are able to trace their source to the food getting into the digestive organs. It is immaterial whether bacteria or their products are the poisons producing the different forms of gastric and intestinal catarrh, and their consequent pathological changes, as long as we know how these germs of disease enter the body; and this question, so much debated up to within a short time ago, we may now class among those settled once and for all.

The revolution this condition has brought about in the treatment of these ailments is apparent. Prophylaxis has taught us the proper preparation of infants' food and especially its sterilization, and it is gratifying to notice the wide-spread interest taken in this preventive measure, although, on the other hand, we may readily see in some of our medical journals that quite a number of the authors of the typical papers on summer diarrhœa have no more a correct idea of exact sterilization than many practitioners as yet have of antisepsis in surgery.

If, then, modern research compels us to prevent the entrance of infected food into the child's stomach and intestines, then logically it ought also to compel us, where such infection does occur, before all other measures are resorted to, to empty these organs of the remaining noxious material. We can here state that the profession here and abroad, with few exceptions, has been too conservative and too theoretically slow in following this imperative indication,—an indication so clear and logical that in the great majority of these cases we might put it into these few words: "Clean the stomach and the intestines and your patient is cured."

This indication is not a new one. The best practitioners have followed it up with medicinal agents long before bacteriology was thought of. But we cannot cleanse a stomach with calomel or castor oil in such a manner as to call it clean afterwards. Epstein's proposition to employ Kussmaul's method of stomach-washing in infantile gastro-intestinal catarrh had been overlooked for nearly eight years; and though Baginsky has made bowel-washing popular, and many of us have adopted it, yet, on the whole, we may say that but very few practitioners at the present date think of treating each and every case of infantile diarrhœa by large enemata.

It is not my purpose to go into detail to-day, as I have done that before in a paper published in the ARCHIVES OF PEDIATRICS in April, 1889; but I simply wish to encourage practitioners in general to at least give this mechanical treatment a fair trial, and for this purpose I venture to report my experience to this Society. Knowing that this first meeting of the American Pediatric Society will be followed up with great interest by a large number of medical men, I hope that this may help to make known this mechanical method, so as to benefit as many little patients as soon as possible.

Since September 1, 1887, I have treated all cases of intestinal catarrh in children under three years of age under my care by bowel-washing, and all cases of acute gastro-intestinal catarrh (cholera infantum) by stomach- and bowel-washing combined. In chronic enteritis, resulting in atrophy and marasmus, I have also washed both organs invariably, and in severe cases of infantile dyspepsia I washed out the stomach.

My cases came under observation in private practice, in the children's department of the New York Polyclinic, and of the German Dispensary. I include all cases treated by Dr. H. W. Weber, my assistant at the Polyclinic, as they were also nearly all seen by me, and also those of Dr. R. Stein, my colleague at the Dispensary, who has kindly added his cases of the last twelve months, making in all fourteen hundred and four cases of gastro-intestinal catarrh in infants and children under three years of age.*

Stomach-washing was employed in five hundred and twenty-one cases. The great majority of these were cases of cholera infantum (acute gastro-intestinal catarrh). Of those who reported again I can record six deaths. Every child not alone stood the washing well, but also rallied more or less in every instance from the collapse it was in before washing. Not one child grew worse from this procedure, and even in the fatal cases the children evidently felt relieved; and not once did depression, convulsions, or death occur immediately after the washing.

In all cases of entero-colitis stomach- and bowel-washing were employed. All children were evidently relieved, but those cases in which true inflammation of the intestines with peritonitic irritation had developed usually ended fatally, though nausea ceased in every instance and the temperature was usually lowered. These cases numbered eight, with six deaths.

My chronic cases (about one hundred) all got well with one exception, where the mother was suffering from acute tuberculosis and the child had been coughing since it was four weeks old. The child failed constantly and died when two and a half months old.

All cases of intestinal catarrh (diarrhœa), whether mild or severe, were treated by bowel-washing performed from one to three times daily. The effect was most gratifying to the children, their colic and pain usually subsiding. In this class of cases I did not have to sign a death certificate at the Dispensary during June, July, and August of this year, hitherto an unusual result during these summer months. The enemata were given with plain warm water, medicinal additions only being made in cases of follicular enteritis with bloody stools, where a weak solution of nitrate of silver (1 to 500) was injected after the bowel had been cleansed by sterilized water.

Severe forms of dyspepsia in infants were all cured by

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* The cases were not tabulated, as some could not be followed up, for the children were not brought back, and therefore these statistics are given with the full understanding that they are not perfect.

regulation of diet and stomach-washing, after most cases had failed to get well on proper dieting alone. Among the dyspeptics was the youngest patient, my own child, then thirty-six hours old. This little girl vomited everything brought into its stomach, including mother's milk, black tea, and plain water. As its little brother, now two years old, had suffered in a similar manner during the first week of his life, weakening him considerably and leaving an exquisite dyspepsia for weeks after, I determined to clean out the stomach of the baby, which evidently, like its predecessor, had swallowed water and mucus during birth. My supposition proved to be correct, for a considerable quantity of water and mucus left the stomach on the catheter coming into the fundus ventriculi, and after a thorough cleansing with warm water the nausea disappeared. The baby stood the proceedings perfectly well (being no more disturbed than if its throat had been inspected by means of a tongue-depressor, and that only in the beginning), although it only weighed seven pounds and had retained no food since birth. It took the breast thirty minutes after the washing and retained the milk, then and since.

A number of writers speak of stomach-washing as of a rude method, apt to produce depressing effects and even collapse in the patient. They caution their readers not to employ it in collapsed children. I cannot agree with these writers. The undertaking will only be rude in the hands of those who also cannot look into a throat without great efforts, painful to behold and distressing to the mother and child. I have also never had a refusal by the parents when I did propose this means of helping their offspring. The experiences of these authors appear to be somewhat limited, as not one of them so far has given any figures.

Collapse in cholera infantum, to my mind, is the strongest possible indication for stomach-washing, and I can make this statement: *The deeper the collapse the sooner the stomach and bowel ought to be washed.*

My last case, first seen September 14, was a twin baby thirteen months old. The twin sister had died in collapse due to severe cholera infantum one hour previous to my arrival. Both breast-fed children were attacked simultaneously two days before. The mother had nursed her children from six to ten times at night alone. The living child, like its sister, a strong, well-built baby, was very low, with pulse absent, in deep prostration. The parents expected death. No œdema pulmonum was as yet present, and so I concluded to wash out the stomach and intestines. Though the parents were very ignorant Russians, who could hardly understand me, they readily consented. The child rallied immediately and was practically out of danger the next morning, making a perfect recovery. Of stimulants, only black tea and large quantities of plain water were given; of medicines, only four powders of calomel, each containing one grain.

The catheter I use in stomach-washing is a soft-rubber velvet-eye tube, corresponding in size to a No. 10 steel bougie (Tiemann), or No. 13 A, thirteen inches long. Attached to this is a glass tube six inches long, necessary to thus bring the outer opening lower down than the fundus of the child's stomach, and to better judge whether the escaping fluid is perfectly clear or not before withdrawing the tube. This glass tube is connected with the regular irrigator (Eissner & Co., New York) or with any ordinary clean fountain syringe.

In bowel-washing a fountain syringe will answer all purposes as long as the child's buttocks are elevated sufficiently so as to let the water run up into the transverse and the ascending colon. It is absolutely necessary that so much water should be allowed to flood into the bowel till reactive abdominal pressure of the child throws it out again alongside of the point of the syringe. The water had better be sterilized by boiling thirty minutes.

DISCUSSION.

Dr. Koplik.—I have had some experience with this method. As regards apparatus, Epstein does not use any of the modifications which have been suggested, but still uses the original, consisting of a No. 9 Jacques catheter connected to a rubber tube by a piece of glass tubing and a small funnel. I have seen in a European clinic, where an irrigator was used instead of Epstein's form of apparatus, an assistant, who had had considerable experience, allow the water to flow too rapidly into the stomach, causing convulsions, which continued half an hour. But the child finally recovered.

The reaction is very slight. If the method of Epstein is closely adhered to, the stomachs of children eight days old can be washed out without any reaction. This original Kussmaul funnel and tube is the apparatus which should be recommended to the general practitioner.

We must remember that Epstein's cases do not include our cases of cholera infantum. I have not seen any severe cases of this affection over there. I have had no experience in washing out the stomach in cases of cholera infantum where there is collapse. I should fear that, even if the child did recover, the shock to the feelings of the parents would drive them away.

The diet of the child after the washing out is very important. The simple washing out will not cure the case. Epstein, after washing out the stomach, puts the children for twenty-four or thirty-six hours on albumen water, made by dissolving the whites of two eggs in a litre of water, the whites of the eggs being first beaten up in the water and then filtered. They are allowed gradually to return to the breast. The stomach is washed out half an hour after breast feeding, according to the necessities of the case.

Dr. Keating.—I think that the washing out, so far as it goes, is very well; but there is always a portion that is not reached by the water. We can readily wash out the stomach and the rectum and a portion of the colon, but we do not reach the small intestine, whose calibre may be almost entirely obliterated by congestion and by mucus. In conversation with Dr. Jeffries, the fact was brought out that, if the most perfect form of sterilized food were given, and the food was mechanically arrested by the cessation of peristalsis for any length of time, bacteria would develop in it and provoke serious trouble. This is an important point. We may wash out the stomach and give proper food, but still the acute symptoms will continue and the food disagree. I believe that in these cases the small intestine is affected, and here we cannot reach by the mechanical treatment. The only treatment that we can adopt is to liquefy the mucus by alkaline solutions and to prevent putrefaction. If we use large quantities of water, containing an alkali, as bicarbonate of soda, a certain amount will get through the pylorus, if the operation is performed gently. I have seen good results from that. The difficulty in many of these cases, I believe, lies in the fact that the small intestine is partially blocked up; and in these cases the addition of the alkali is of value.

Dr. Booker.—Dr. Seibert has done a good work in introducing into this country stomach-washing in children. This method of treatment was largely practised at the Thomas Wilson Sanitarium for sick children during the past summer. I agree with Dr. Seibert in regard to the effect of washing out the stomach in cases of collapse. While there were no cases of extreme collapse of cholera infantum at the Sanitarium, there were many of diarrhœa, in which there was a certain degree of collapse; and in these cases great benefit was derived from washing out the stomach.

In summer diarrhœa in children there are certain obvious advantages to be gained by the operation. It rids the stomach of milk curds which accumulate there, and which would otherwise pass into the intestine and produce irritation; it removes the thick mucus, gives the stomach a chance to rest, improves its tone, quiets restlessness, relieves vomiting, and diminishes the number of stools.

I have found mild curds in the stomach four hours after feeding, and have seen them gradually disappear by subsequent washing, and at much shorter intervals after feeding. As a rule, children fall asleep shortly after the operation, and have several hours of good refreshing rest.

Previous to the adoption of this plan of treatment at the Sanitarium, it was often necessary to stop all milk food for twenty-four to forty-eight hours in cases of severe vomiting; but since this method has been used very few cases required any interruption in the milk diet.

Washing out the stomach, though of great advantage in most cases, is not always beneficial, and in some I believe that it may do harm. There have been two cases in which I regretted using the measure; both were feeble, with poor nutrition, and almost dead when brought to the Sanitarium. One child had been taking blackberry juice, and in washing out the stomach a quantity of dark clots came with the milk. These were not carefully examined, and I did not think of blood at the time. The child improved after this washing, and I felt encouraged to repeat the operation the following day, when the dark clots were again noticed, and proved to be composed of blood, and there was a little fresh blood on the end of the tube when it was withdrawn. It is probable that clots were removed from a bleeding surface and a fresh hemorrhage started. The child failed from this time.

The second case also improved after the first washing, but after the second grew worse. In this case the body was chilled by imprudence on the part of the mother soon after the operation, and it is possible that too much water was allowed to run into the stomach siphoning, which it is important to avoid. With these two exceptions, improvement followed from stomach-washing in nearly every case, and in many it was very decided.

Stomach-washing is followed with advantage, in many cases, by intestinal irrigation. This should be done after the child has rallied from the sleep. There is no prostration following this operation, the pulse being strengthened rather than weakened.

Intestinal irrigation has been used at the Sanitarium for the past five summers. I believe the irrigation does affect the small intestine; not that the water enters the small intestine,—though I have known this to happen in two cases,—but that it excites peristalsis and the intestine is emptied. The greatest benefit has been observed in cases where the irrigation was thoroughly done, and a large quantity of fæcal matter brought away.

While the mechanical treatment is of great advantage in the treatment of summer diarrhœa in children, it is not sufficient alone to effect a cure. In acute cases and in the beginning of the sickness, with proper diet, almost all can be cured by the mechanical treatment without medicine. In many cases, however, especially chronic cases, benefit follows to a certain extent, and then no further good appears to be accomplished by this treatment.

Dr. Vineberg.—I have had some experience with this method. As it is disagreeable and takes considerable time, in my opinion, it should derive its value from its beneficial effects in severe cases. Mild cases get well without it. It is only in such instances, then, that I have employed it, and in almost every case the child died. There was some improvement for a time. I observed that vomiting occurred on the passage of the tube into the stomach, and that the fluid came out, not through the tube, but along the side of it.

The President.—What becomes of the large clots which we sometimes see brought up by vomiting? These could not pass through any tube introduced into the stomach.

Dr. Koplik.—Most of the children treated by this method originally were breast-fed; and I doubt whether, in these cases, the clots are so large. It is surprising how large a clot may come through a small tube. They come up in long strings.

Dr. Seibert.—I stated in my paper that I did not wish to go into the details of this procedure. If I had, I should have referred to all these points. The point that I wish to emphasize is that, in washing out the stomach, it must be emptied. In children over two years of age I sometimes wash out the stomach by getting them to drink water and then induce vomiting by inserting the forefinger in the pharynx.

In cholera infantum I fill the stomach rapidly. It is important to get rid of the poison quickly. I let the children vomit. I do not wait for the water to come through the tube. I fill and empty the stomach several times before the washing is completed.

THE PRESIDENT.—I think that in many of these cases the plan of filling the stomach with water and then inducing vomiting would work well. Many of the old writers insisted on the use of an emetic in these cases. An emetic may be safely given to children because they vomit so easily.

I fear that this addition to the therapeutics of the alimentary canal will in a few years suffer discredit which it does not deserve, because too much is expected from it.

The objection of Dr. Keating has great weight. The small intestine is proportionally longer in the child than in the adult. Between the stomach and the sigmoid flexure there are a number of feet of intestine that cannot be washed out. It is in this part that the catarrh is principally located. Therefore the dogma that cases are to be treated by washing out of the rectum and sigmoid flexure alone is dangerous, as the rest of the intestinal tract is not taken care of.

While I regard this as a valuable addition to our therapeutic measures, the fact should not be lost sight of that we need a good deal more. We want a strict diet; we want disinfection of the intestinal canal; we certainly want the alkaline treatment, and, perhaps, many other things. As far as rectal injections are concerned, I need not add that there is not even a shadow of novelty in that.

DR. SEIBERT.—I fully coincide with what the president has said. I do not want to be understood as saying that the mechanical treatment is the only treatment. It is only a symptomatic treatment. It is one part of the treatment that we should employ. In these cases it is imperative that we should remove decomposing material, bacteria and their products, which accumulate more in the lower portion of the bowel than anywhere else. I believe that we can cure cases better and quicker in this way. We can, of course, employ medicines and regulation of the diet besides.

THE PRESIDENT.—I have washed out the intestines constantly for twenty-five or thirty years, but I know that we cannot get the water beyond the sigmoid flexure. In the infant there is such a length of descending colon that instead of one flexure there may be two or three, the colon extending to the right side of the pelvis. In the adult we sometimes succeed in reaching the valve and occasionally going beyond the valve. We cannot do that in children. While we may rely upon irrigation in catarrh of the rectum and other forms of dysentery, we know that we can reach only the lower part of the colon, unless we raise the pelvis above the level of the chest. In that case, particularly under the influence of an anæsthetic, which I use to overcome intussusception, the fluid will enter the colon.

Dr. Caillé.—During the past six months I have performed some experiments to see how far fluids could be introduced into the gut. I have taken a fountain syringe, holding three quarts, and elevated ten feet. I tried to force water above the valve in the cadaver in ten cases, but failed in every one. I also attempted to overcome the difficulty by introducing a long rectal tube as far as it would go, but in no case did the water go above the valve. These experiments correspond with my observations on the living, and thus I am convinced that only in very exceptional cases will it be possible to irrigate the bowel above the cæcum.

A CONTRIBUTION TO THE STUDY OF THE SUMMER DIARRHŒAS OF INFANCY.*

BY JOHN A. JEFFRIES, M.D.,

Boston.

Before entering into the details of this paper it is necessary to define briefly the range and scope of the subject. Every physician is familiar with the summer diarrhœas and the generally accepted belief that heat and fermentation are at the bottom of the trouble. No common standard of classification, however, is in vogue: some call everything cholera infantum; others gastro-duodenal catarrh, summer or green diarrhœa. Some deny that the symptoms give a proof of the *locus morbi;* others speak of gastritis, catarrh of the small intestine, colitis, proctitis, follicular enteritis, and the like. Others, yet again, say that the diarrhœa is only a symptom, and that we must

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* The bacteriological work of this paper was done in the laboratory of the Harvard Medical School, for the liberty of which I am much indebted. This paper was written in January, 1889.

look to other organs for the foundation of the disease,—for instance, the splanchnic ganglia.

My own observations lead me to agree with those who hold that, ruling out syphilis, tuberculosis, typhoid and other specific diseases, there remain a vast number of cases characterized by diarrhœa, vomiting, wasting, often fever, which occur chiefly in hot weather. It is these cases which are intended to be included under summer diarrhœa. They form a group or genus with few definite species of disease, but a great number of forms, no two exactly alike, yet so closely running into each other, and forming series, as to preclude all possibility of a reasonable separation. All show more or less signs of catarrh of the alimentary canal in one part or another, generally the whole. But this catarrh expresses itself, or is accompanied, by a variety of symptoms. Diarrhœa is the rule, but constipation may take its place. In color the stools are brown, black, yellow, red (from blood), or most often green. The amount of water is very variable, but mostly in excess; in odor they follow the whole gamut of fermentations and putrefactions. Gastric disturbances, as indicated by vomiting of undigested or fermented food, follow closely after the diarrhœa in frequency, while wasting, abdominal tenderness, fever or subnormal temperature, alterations in the urine, and variable nerve-symptoms bring up the rear.

Anatomy and physiology.—The alimentary canal of the infant is not like the adult's, though built on the same plan. It is therefore desirable to consider the variations from the adult organs. In the mouth are to be noted the absence of teeth during the first months of life, and then their growth; also the dryness of the whole cavity. This dryness is due to the scanty supply of saliva, which is also lacking in saccharolytic powers. The œsophagus offers nothing of note. The stomach varies materially from that of the adult. It is very small, even down to thirty-five to forty-three cubic centimetres at birth, growing rapidly to one hundred and fifty-three to one hundred and sixty at two weeks, and about seven hundred and forty cubic centimetres at two years (Beneke).* In shape it

* Beneke, *Deutsche Med. Wochensch.*, 1880, p. 433.

lacks the cardiac enlargement, and is proportionately smaller along the greater curvature, which, by the bye, looks forward rather than down. Thus, as the infant lies chiefly on its back, the so-called posterior surface must form the true floor of the organ. The stomach walls are thin at the expense of the muscular layers, the submucosa well developed, and tending to a liberal supply of round cells. The epithelium proper is nearly that of adults, and varies only in the smaller glands, delamorphic and adelamorphic cells being present (Baginsky).*

The chief elements of gastric digestion—pepsin, hydrochloric acid, and milk ferment—are represented, but less in quantity than in adults.

Lastly, Leo has found, as the result of examining thirty healthy infants, that the fasting stomach is always acid; that a considerable amount of the milk, especially if breast-milk, has left the stomach in an hour; that during its stay in the stomach the milk slowly takes up the acid, so that but little free acid is left.

The intestines are described by Baginsky—with whose observations my own on young animals agree—as having but a thin muscular layer and a poorly-developed mucous layer,—that is, the villi, crypts of Lieberkühn, and Brunner's glands are only partly developed and few in number. On the other hand, the follicular and lymphoid tissue of the intestine is well developed, and occupies a more prominent position than in the adult. These differences point to less chemical action on the part of the intestine and more absorption than in the adult, conditions to be referred to later.

The ratio of the length of the intestines to the body is greater in infancy than in adult life; thus, 57 : 10 at birth, 66 : 10 at two years, almost 47 : 10 at thirty years. (Beneke.)

The pancreas is slow in assuming its functions, and develops *pari passu* with the salivary glands. The liver offers little difference in structure, is variable, but large in size. The bile, however, according to recent investigations,† is remarkable for the small amount of the inorganic salts, except those

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* A. Baginsky, *Virchow's Archiv*, vol. lxxxix. p. 64.

† Jakubowitch, *Jahrb. f. Kinderheilkunde*, 1886, p. 373.

of iron, cholesterin, fat, lecithin, and bile acids; glycocholic acid is absent.

Glancing over these differences, it is clear that the digestive tract must lack muscular power; the stomach is not prepared to do much churning, or the intestines to pass on heavy, solid material. The chemical side of digestion is also weak; the stomach is known to be less active, and the same must be true of the intestines, with poorly-developed glands and the less active liver and pancreas. Absorption, on the other hand, would seem to be very good, judging from the relative length of the intestines and the advanced development of the lymphatic system.

These differences amply explain why the diet of infants should be so limited, and that even cow's milk, diluted, produces fæces abounding in proteids, as shown by Biedert.*

Pathology.—The pathology of summer diarrhœas is by no means so well known as might be expected from the prevalence and mortality of the trouble. With scores of thousands dying yearly, reports on the pathology, accompanied by complete clinical histories, scarcely exist. The older authors, as Rilliet and Barthez,† report the results of a large number of autopsies, but their views of pathological processes were so different from those of to-day as to render them of comparatively little value.

Many of the more recent works simply make a few broad statements, devoid of all data as to source, which render them useless to the worker, in view of the confusion still reigning on the subject. It is therefore not possible to give any systematic description of the pathology in relation to symptoms,—indeed, those who have reported most autopsies deny any relation between the two,—but it is possible to gather a pretty clear idea of the changes which occur in the stomach and bowels.

First, it is to be noted that a child, especially if very young, may die, and the autopsy reveal almost nothing; also that, speaking in general terms, the longer the trouble has lasted the grosser are the lesions found.

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* Biedert, *Jahrb. f. Kinderheilkunde*, 1888, p. 344.

† "Maladies des Enfants," 1838.

The stomach has not been made the subject of examination as often as the bowels, but a sufficient number of reports exist to give a clear idea of the general process involved. All have found the stomach less affected than the bowels, both in number and in extent. Thus, J. Lewis Smith* found it normal in forty-two out of fifty-nine cases. The first changes are probably vascular with a coincident disturbance of the digestive functions, the digestive fluids being altered as to quantity and quality, and an increased amount of mucus produced. Hyperæmia may fairly be taken as the commonest change, but it must not be forgotten that in many autopsies the stomach is found pale. Shortly a more or less severe catarrhal inflammation is set up, which effects material changes. The submucous becomes infiltrated with leucocytes, and the cells of the mucous layer swell, become filled with mucus (increase of beaker cells), and cloudy. This change holds good of both the cells on the surface and in the crypts; the tendency is for the degenerated cells to fall off, leaving more or less bareness behind.

The changes induced by the degeneration of the mucous cells and the round-cell infiltration lead to the last stage, that of erosions,—that is, places devoid of the mucous coat, and the seat of more or less reaction. From here on the changes are either an increase in degree or those of resolution. If no erosions have been formed, it is easy to return to the normal by diminution in the amount of mucus, regulated circulation, and disappearance of the round cells. If erosions are present, it is generally accepted that small ones heal by the mucous coat growing from the edge and remains of the follicles, large ones by granulation. Where there has been extensive infiltration of leucocytes, connective tissue is formed, which by pressure destroys the crypts,—that is, atrophy results.

The contents of the stomach vary greatly, from a little mucus to a muco-purulent phlegm mixed up with the remains of all sorts of food, the mucus, curds, and fluid often making a most revolting mess. During life Leo,† by washing out the stomach, has found that gas and mucus are apt to be abundant,

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* J. Lewis Smith, "System of Medicine." Pepper. Vol. ii. p. 726.

† Leo, *Berl. Med. Wochenschr.*, 1888, p. 981.

and that the food lingers in the stomach even for seven and a half hours.

Cholera infantum proper—meaning the symptom complex of cholera nostras in the adult—seems to offer a rather different picture. Here the stomach is pale, mucosa softened and shedding submucosa, thickened, soft, round-cell infiltrated, a sort of inflammatory œdema, cut short by death.

The changes in the bowels are diversified from those of the stomach by the introduction of the follicular elements. The upper part of the intestine has a tendency to paleness and little more, while lower down hyperæmia predominates. Thus Smith, in eighty-two cases, found hyperæmia of duodenum and jejunum twelve times; paleness only fifty-one times; hyperæmia of ileum sixty-three times; of colon eighty-one times. This is worthy of note: the parts where the food passes most quickly are relatively free from change. But it must also be borne in mind that the lower parts of the intestines are exposed to the unhealthy conditions inevitably induced by disease above. An unhealthy bowel cannot pass on healthy chyme.

The hyperæmia is most often diffuse in the submucosa, the microscope showing it to be venous, at times stellate.

The changes in the mucosa of the intestines are similar to those of the stomach, and consist in swelling, cloudiness, and many mucous cells. The latter show very clearly in sections, stained, according to Gram, for bacteria. The villi are naturally liable to lose their epithelium early, but autopsies are made so late that all minute points of this sort are insecure. The submucosa is the seat of a round-cell infiltration, often extensive, extending through the muscle-coats along the chief lymph-channels.

The follicles, solitary and agminated, seem to vary considerably, but a review of many statements shows clearly that there is a strong tendency to crowding with round cells, which, if carried to an extreme, results in necrosis and the formation of an erosion or ulcer. These ulcers occur chiefly in the small follicles in older infants. Lewis Smith found no erosions of Peyer's patches in his eighty-two cases referred to before.

The contents of the intestines vary in consistency, color, and odor from case to case. There is generally a good deal of mucus; the green color so often seen in the stools occurs in the lower parts. Its origin has been much debated, but by general consent is attributed to biliverdin. The fact noted long ago by Bednar,* that stools passed on diapers washed in lye turn green, and the late article by Pfeiffer, seem to show that the green color is an indication of alkalinity of the chyme. Pfeiffer † holds from experiments that no acid known to occur in the bowels turns yellow stools green, while alkalies do so quickly. He also found bicarbonate of soda, when given to a three-months infant, to produce green stools. In my own practice, however, I have often seen green stools become normal while bicarbonate of soda was being administered.

Kunrad ‡ and others distinguish pathologically as well as chemically a distinct follicular enteritis, in which the changes noted above occur alone or with only slight patches of catarrhal inflammation of the mucosa.

The mesenteric glands undergo changes similar to the follicles,—that is, crowding with round cells and consequent swelling. The changes of other organs are by no means so well agreed upon, but the weight of evidence is clearly in favor of the view that the liver may be enlarged, engorged, contain more than the normal amount of fat (Hallowell),§ and may also be the seat of round-cell infiltration (Gilbert).||

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* Bednar, "Die Krankheiten der Neugeboren und Säuglings von Klinischen und pathologisch-anatomischen Standpunkte," 1850–1853.

† Pfeiffer, *Jahrb. f. Kinderheilkunde*, 1888, 164.

‡ Kunrad, Gerhardt's *Lehrbuch der Kinderkrankheiten.*

§ Hallowell, "Enteritis, or Summer Complaint of Children," *Am. Jour. Med. Sci.*, 1847, p. 40.

|| Gilbert, "Note sur deux Cas de Choleré Nostras," *France Méd.*, 1887, p. 1749; see also Rokitansky, "Handbuch der Patholog. Anat.," iii. p. 291; Parker, *Trans. Med. Soc. of New York*, Albany, 1857, p. 91; J. Lewis Smith, *Am. Med. Times*, New York, 1862, p. 160; Henoch, "Wood's Library," 1882; Birch-Hirschfeld, "Lehrbuch der Pathol. Anat.," 1882; Ziegler, "Lehrbuch der Allgemeinen und Specialen Pathologischen Anatomie," 1884; Starr, "Diseases of the Digestive Organs in Children," 1886; Biedert, "Lehrbuch der Kinderkrankheiten." Von Vogel. 9te Aufl.; neu bearbeitet, 1887; Baginsky, "Lehrbuch der Kinderkrankheiten für Aertze und Studirende," 1887; Holt, *Medical News*, Philadelphia, 1888, p. 644.

The kidneys show at times a cloudiness and swelling of the cortex, not to be wondered at in view of the albuminuria noted by observers. The changes in the brain and lungs are so clearly the result of marasmus as to require no notice.

Etiology.—Passing now from the pathology to the etiology and nature of the disease, we find the following causes accepted in order of time: heat, improper feeding as such; fermentation, especially with improper feeding, reduced during the last year or two to bacteria. Lately the bacterial side of the question has shown a tendency to usurp the field, as cause proper, as is shown by the claims put forward for specific germs and the so-called antiseptic treatment. Besides the three causes mentioned, catching cold, predisposition, heredity, have been frequently pushed for a place.

That improper diet may bring about diarrhœa is so evident as scarcely to need note. But pickled lobster or other irritant food, even in the hottest weather, does not bring on a set attack of summer diarrhœa. The infant will vomit, purge, like as not have convulsions, when a physician will be called and the child be well in a day or two. Barring convulsions, the thing tends to take care of itself, the food which irritates is ejected, the cause is removed, and the trouble vanishes. Could a simple indiscretion of diet cause summer diarrhœa, scarce a child would grow up, unless guarded by a picket of soldiers, such is the desire of old and young to give an infant whatever it appears to cry for. No sooner grasped than it goes to the mouth, the seat of the one fairly developed sense. Again, the epidemic occurrence of summer diarrhœa, especially during hot spells, points to causes decidedly influenced by the weather. Simple indiscretions are not so connected. It is therefore clear that the trouble under consideration is not caused by simple indiscretion in diet. This does not, however, preclude such articles of diet from setting up conditions favorable to the action of one of the true causes. Such is undoubtedly the case. The ingestion of various improper foods are too often followed by set attacks of diarrhœa to be the result of pure coincidence.

There is another class of improper feeding,—that is, with continuous improper food. Such foods do not transgress the laws of physiology so outrageously as those of the first group; indeed, certain infants are capable of flourishing on any one of them. The various substitutes for breast-milk are referred to, varying from cow's milk to cow's milk plus some compound of vegetable origin, most all proprietary, and each the only proper artificial food. With all these foods it is merely a choice of which is the least bad; none are as good as human breast-milk. As a result, many children sicken, waste, and show various symptoms of digestive disturbance, while others are simply feeble and do not flourish. On the other hand, a good proportion do very well, and grow up to be strong, healthy children. This alone shows that even continuous bad feeding, which of necessity cannot be very bad, though the cause of much disturbance, which reduces the child to a state readily to fall a victim to disease, is not in itself a sufficient cause of the trouble under consideration.

Again, like mildly bad feeding, this chronic bad feeding is perennial,—summer diarrhœa limited in time,—things connected as cause and effect must vary together. Foods as foods may therefore be ruled out as a direct cause. It is nevertheless clear that breast-fed children do better and suffer decidedly less from diarrhœa than the bottle-fed, but the breast-fed are by no means exempt. Buller * gives figures for 40,314 cases, from Bavaria, under one year; of these, 6753, 16.9 per cent. were breast-fed, 83.1 per cent. artificially-fed, of which, 58.7 per cent. were so fed from necessity. Monti, in 208 cases, found 21 were breast-fed; that is, 10 per cent. Johnston † found in 238 cases occurring in Leicester, England, 165 were breast-fed, 56 bottle-fed, 17 both. These figures show that the breast-fed are not exempt, that variations in proportion occur, thus rendering it unsafe to try to draw conclusions from any one man's experience. It is only fair to note here that all the tables and figures in regard to

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* Buller, "Ursachen und Folgen des Nichtstillens in der Bevölkerung Münchens," *Jahrb. f. Kinderheilkunde*, 1887, p. 313.

† Johnston, after Uffelmann, "Zur Aetiologie der Cholera Infantum," etc., *Deutsche Med. Wochensch.*, 1888, No. 10–13.

this matter ignore the ratio of the breast-fed to the bottle-fed in the community from which the figures are derived. Without this the figures show nothing as to the relation of feeding as a cause.

The weather, or, more properly, climate, including crowding, has been the subject of much consideration since the time of Benjamin Rush. A great many articles have been written and tables published tending to show a more or less close connection between the weather and summer diarrhœa. Any one of the tables seems to prove something, and nearly every one can be offset by another pointing the opposite way.

The first thing noted in studying health reports is that the great mass of deaths from diarrhœa are before the sixth year; indeed, in the first two and a half years. The following figures from the tenth census show this clearly:

Total number of deaths of all ages during census year, 756,843.

	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.	Total.
Deaths from all causes	175,184	58,816	33,417	21,276	15,931	302,624
Diarrhœa	4,393	2,089	681	232	100	7,496
Dysentery	3,356	2,891	1,403	531	303	8,484
Enteritis	3,611	1,498	700	356	220	6,385
Cholera morbus	276	155	70	35	19	555
Cholera infantum	16,762	6,307	1,443	307	131	24,950
Total from diarrhœas	27,398	12,941	4,297	1,562	773	47,870

The total figures for all ages for the five diarrhœal diseases given being 10,825, 13,427, 12,640, 2116, 24,983; all together, 63,991. Roughly, three-quarters of the deaths from diarrhœal troubles occur during the first five years. In other words, it is the diarrhœas of infancy which are fatal. Owing to the wild and careless diagnoses so common in death-certificates, the special figures are of no value, and the totals for diarrhœal troubles in infancy are well known to be too small, many cases being classed under convulsions, wasting, and the like.

Turning from the time of life to the locality in which diarrhœa prevails, it at once becomes clear that there is no set law. As a rule, the trouble prevails in the cities, and most authors speak of the trouble as an urban complaint. But, as Johnston pointed out, the death-rates in the different cities vary greatly, with little regard to location or the occupation of the people, and Haven * has shown that the small town of Nantucket gives a death-rate of 2.14 as compared with 1.66 in Boston. It is of interest, therefore, to see what figures on a large scale show.

Below is a table derived from the tenth census, the deaths from diarrhœa, enteritis, dysentery, cholera morbus, and cholera infantum being classed together and contrasted with the total deaths:

		All Ages.	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.	Under Five Years.
Western Massachusetts....	Total............	7,115	1,269	337	226	176	138	2,146
	Diarrhœal.....	431	261	49	20	3	2	336
Cities...............................	Total............	15,972	4,237	1,148	598	463	347	6,793
	Diarrhœal.....	1,451	924	213	32	16	9	1,195
Alabama, Group I............	Total............	1,034	190	53	32	28	13	316
	Diarrhœal.....	86	32	14	5	3	0	54
Arizona	Total............	291	56	11	9	4	0	80
	Diarrhœal.....	12	3	2	1	0	0	6
Indian Population............	Total............	903	114	52	42	32	19	257
	Diarrhœal.....	48	5	10	8	5	3	31

These figures alone are perplexing, but if analyzed are capable of throwing some light on the subject. The infant mortality must be compared with some stable factor. The total deaths are of little value, the life and average age of the populations differing too widely. The total deaths from diarrhœa seem to offer a better comparison; but as almost all the deaths above infancy from diarrhœa belong really among the specific diseases, it is clear that a comparison with infant mortality could only furnish a rough index of wrong diagnoses. There thus remains nothing but the total infant mortality, the one usually chosen and fairly satisfactory. This comparison gives the following percentages: Western Massachusetts,

* Haven, "The Etiology and Treatment of the Summer Diarrhœa of Infants," *Journal of Pediatrics*, 1886, p. 395.

15.6; cities, 17.6; Alabama, Group I., 17; Arizona, 7.5; Indian population, 12.

These figures show nowhere near the difference between city and country mortality that should exist to justify characterizing the trouble as urban. They are not very accurate,—no such figures are,—but they are on too large a scale and from too diverse localities to be explained as accidental. It must be concluded, therefore, that summer diarrhœa, though tending to excel in the cities, is still a very common complaint in the country,—a conclusion which has always had its strong supporters. Dr. Farr's table, quoted by Curtis,* certainly shows a disproportionate increase of infant mortality with increased density of population; but this shows only general mortality in England, and is equally applicable to almost any disease.

It has always been a pet theory that heat is the cause of cholera infantum, and several pages would be required to cite the authors who have made this statement. Later efforts have been made to connect the trouble with humidity, pressure, rainfall, velocity of wind, ground temperature, and the jack-in-the-box ground water level. To be accepted as causes, they should be shown to vary with the morbidity and mortality in any place of moderate size. This has not and cannot be done. Baginsky,† by careful study in Berlin, has clearly proved that ground water and ground temperature cannot be regarded as causes.

Seibert‡ has made so exhaustive a study of the relation of this disease to the weather, in New York, that it is only necessary to refer to his results. He has shown that the general morbidity curve runs up shortly after the curve of summer heat, but declines rapidly while the temperature is still practically unabated; that neither hot weather, moisture, pressure, rainfall, wind, nor water-supply vary with the disease. But Seibert also showed that the mortality rose as soon

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* Curtis, "Buck's Hygiene and Public Health," vol. ii.

† Baginsky, *Jahrb. f. Kinderheilkunde*, 1875.

‡ Seibert, *Medical Record*, 1888, vol. xxxiii. p. 307, and vol. xxxiv. p. 153.

as the daily minimum of 60° F. was reached, thus more closely formulating Baginsky's statement that the disease is produced under the influence of continuous warmth.

While treating of heat, the theory of Meinert* requires mention. This author has strongly urged the theory that summer diarrhœa is really nothing but heat-stroke. His argument is hard to grasp, but seems to be based on the prevalence of the disease during hot spells, and the view that the diarrhœa is not sufficient to cause the general symptoms. Meinert uses the word "hitzschlag," but does not seem to distinguish between the two forms,—insolation, with coma and extreme hyperpyrexia, and simple heat-collapse without hyperpyrexia,—the first tending to result from exertion in a very hot sun, as shown by the experience of the British troops in India; the second occurring in any hot place, as the furnace rooms of steamers, in previously debilitated patients. He would seem, however, to mean the latter form, heat-collapse.

In Germany heat-collapse may be a rare affection among children, but in America this can scarcely be said. Every physician has more or less cases manifestly due to the effects of heat, some tending towards true insolation and others to heat-collapse. The symptoms in these cases are variable; but diarrhœa does not constitute a leading symptom, embarrassed circulation prevailing.

Returning to summer diarrhœa, it is clear that if it is heat-stroke, the morbidity and mortality curve must run with the temperature,—a very hot day giving many cases, the same as with adults. This relation Baginsky did not find in Berlin, and it is clearly disproved by Seibert's figures for New York. Very hot days are not of any necessity days of many cases of summer diarrhœa.

Lately figures have begun to appear, intended to prove crowding as a cause in common with heat. But crowding is a cause of mortality among all ages, and aggravates every sort

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* Meinert, "Sechszig Versammlung Deutscher Naturforcher u. Aertze in Wiesbaden," *Centralb. f. Bakteriologie u. Purasitenkunde*, 1888, p. 567, and Bd. iii., 1888, p. 641.

of disease; it must therefore be regarded, not as a cause, but as a condition facilitating infection in a thousand ways, and also diminishing the system's power of resistance. In this connection Widerhofer's* figures are worthy of note; in the Vienna asylum the brunt of the attack came in the first quarter in three out of five years, the worst months of each year being January, March, April, and July twice. The epidemics in the winter were associated with extreme crowding of the institution, owing to the desire to protect the children from the cold.

To sum up the conclusions reached as to the efficacy of the causes so far considered: Food, either manifestly bad and occasionally given, or approximately good and continually given, are not causes, but tend to induce, pave the way for, the disease. Crowding increases the mortality, as in every other disease. No climatic conditions show a close accord with the disease except a high minimum daily temperature, fixed by Seibert for New York at 60° F.; and even this is not sufficiently close to justify the assumption of being a direct cause.

This brings us to the last group of causes, the one lately urged from various stand-points by nearly every close observer who has written upon the subject. Eichhorst,† Escherich,‡ Baginsky, Seibert, Widerhofer, and a score of others have pronounced in favor of bacteria.

Bacteria I believe to be at the bottom of the disease,—that is, rule bacteria out of all foods and the alimentary canal, and summer diarrhœa would cease to be. The writer's work has all been directed to elucidate this subject as offering the key to the causes, pathological processes, and, let us hope, treatment and surely prophylaxis. As the literature of the subject has, up to June, 1888, been recently reviewed, only a few facts will be briefly mentioned, my work given, and then an effort made to put the whole into a working form.

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* Widerhofer, Gerhardt's *Jahrbuch der Kinderkrankheiten.*

† Eichhorst, "Handbuch der speciellen Pathologie und Therapie," vol. iii. p. 172.

‡ Escherich, "Die Darmbakterien des Säuglings und ihre Beziehungen zur Physiologie der Verdauung," 1886.

It is now well known that many forms of bacteria can not only pass through the stomach, but live in it, and Macfadyen* has shown that even the sensitive cholera spirillium will pass directly into the intestines, if given in water to a thirsty, fasting animal; to remain in an ordinary stomach the plant must be able to resist the effect of the gastric juices during digestion. This not a few can do, and Miller† has isolated several active fermenting kinds by which carbon dioxide, hydrogen gas, and organic acids—lactic, acetic, butyric—are produced from the stomach. As a whole, however, we have no accurate knowledge of the bacteria of the stomach; there may be certain constant forms, or they may change with the ingesta. Leo ‡ has recently stated that plate cultures made from the stomach contents fifteen minutes after feeding contain many bacteria, while plates made an hour after feeding show few or no colonies.

A large number of forms have been isolated from the fæces of adults and infants, especially by Miller,† Brieger,§ Vignal,|| and Escherich;¶ but with few exceptions no author has been able to connect his forms with those described by others. This is due to the general difficulty of determining species from books, experienced in the whole province of natural history, enhanced by the peculiarly insufficient descriptions given of most bacteria.

Escherich's work, however, though it has not greatly advanced our knowledge of bacteria in the intestine from a systemic point, has given us some data of great value, and placed the whole question in a new light. This author has shown that the bacterial flora varies with the food,—a mixed flora in the meconium, a definite one with milk food,—that is,

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* Macfadyen, *Jour. of Anat. and Physiol.*, 1887, vol. xxi. pp. 227 and 413.

† Miller, *Deutsche Med. Wochensch.*, 1884, p. 781; 1885, p. 843; 1886, p. 117.

‡ *Berlin. Med. Wochensch.*, 1888, p. 981.

§ *Zeitschrift. f. Physiol. Chem.*, 1884, p. 306.

|| Vignal, *Archiv. de Physiol.*, 1887, p. 492.

¶ Escherich, "Die Darmbakterien des Saüglings und ihre Beziehungen zur Physiologie der Verdauung," 1886.

there is a regular flora for milk-fed infants. This is characterized by the great predominance of two species, one predominating in the upper part of the intestines, and the other in the lower part. The first, his bacillus lactis aërogenes, is a facultative anaërobic species, capable of fermenting milk-sugar into acetic acid, hydrogen gas, marsh gas, and carbon dioxide being given off. The second bacillus, living in the lower part of the intestines, has a fermentative action, producing alcohol and a trace of acetic acid, and also has a powerful action on proteids and fats. Besides these two regular forms, Escherich has described several others of more or less common occurrence. This set flora, contrary to the confusion that might be expected, is due to the rigid requirements of the case. To flourish in the upper part of the intestines the plant must be able to live with little oxygen, to withstand the effects of the digestive fluids, be able to live on the chyme as found there, and have no pathogenic powers under the conditions given by healthy digestion. These conditions are quite far-reaching, and limit the properties of the plants very closely, especially as milk, though a good universal medium to sustain life, is not adapted to full development of many species. The sugars are represented by a rather permanent kind, the fats are slow to decompose, and casein, as shown by Escherich, is a decidedly resistant form to the decomposers of proteids.

In the lower part of the bowels little of the milk is left in the breast-fed, and the forms living there must depend chiefly on the secretions and excretions of the bowels. It is not improbable that Brieger's bacillus in the lower parts depends upon the mucus for its support. In children fed with cow's milk the bacilli have the advantage of a good supply of casein.

Once given the bacillus lactis aërogenes and Brieger's bacillus in the intestines, every other form which might happen to slip in would have not only to fulfil the conditions made by normal digestion, but also to struggle with species already established.

With these forms in the intestine, any variation in the conditions—that is, change of food or changed secretions or excretions from the digestive tract—might render it possible for them to develop pathogenic qualities. Thus Baginsky advances the theory that the lactic acid form may thus run riot, and produce sufficient changes in the food to cause intestinal trouble, and even by excess of acid kill itself. This will be referred to later.

The knowledge of a set normal bacterial flora renders it possible to study the flora or floræ of disease with a fair hope of finding pathogenic forms, if such there be. By isolating all the forms possible, if any specific forms exist, they should be found regularly occurring, and by experimenting on animals similar troubles might fairly be expected to result. Fairly, since young animals offer much the same conditions as infants, and in normal life suffer from summer diarrhœa. Any one who tries to bring up kittens by hand during the summer is liable to see his pets die just like the children.

So far as known, but very little work has been done in this line. Escherich has noted an increase of the spirillium forms in the cases of watery diarrhœa, but holds them to be a result, not a cause.

Lesage * has described a most bizarre form of plant, which, he claims, produces the green color in the stools, is easily grown, and kills animals, with green diarrhœa, however introduced, as the specific form. This it certainly is not; no such forms regularly occur in the stools; in fact, nobody else has since been able to find it.

Booker † has isolated the bacteria from sixteen cases of summer complaint (used in my sense of the word), and found eighteen species, which he has lettered. Without entering into their biological characters, which are unfortunately not sufficiently given, the relation of the species to the cases and the results of his experiments on animals require note.

Bacillus A found in five out of seven cases of cholera infantum. Milk cultures, one to six weeks old, fed to three mice and three young guinea-pigs, caused death in from one to eight days. One mouse had diarrhœa. Autopsy.—Nothing found except emaciation and Bacillus A in the organs, and as

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* Lesage, *Archiv. de Physiol.*, 1888, p. 212.

† Booker, *Transactions of the International Medical Congress*, Ninth Session, 1887, vol. iii. p. 598.

almost pure cultures in intestines; more or less drowsiness produced in the animals: kittens not susceptible. Eighteen-day bouillon cultures, sterilized, injected into jugular vein of three rats: all died. Nothing found at autopsy, unless possible congestion of vessels on posterior part of brain. Unsterilized fresh cultures produced no effect.

Bacillus B, found in ten cases, showed decided pathogenic properties. Milk cultures fed to three mice produced death in from two to four days; nothing found at autopsy except B in the organs and intestines. A mouse, young kittens, and young guinea-pig gave no results; cutaneous inoculation produced death, at autopsy resembling malignant œdema.

Bacillus D found three times. Milk cultures fed to four mice and one kitten; one mouse died; nothing found except emaciation and plant in intestines. Cultures administered under the skin killed two mice and two guinea-pigs. Autopsy revealed only local inflammation and plant in organs.

Bacillus F found in one case.

Melted gelatin cultures, administered subcutaneously, killed two mice. Autopsy showed only many bacilli at point of inoculation. Bouillon cultures failed. In ear-vein of rabbit, no result. Feeding four mice and one kitten gave no result; after croton oil and feeding, two mice died. Autopsy only showed plant in intestine.

The other forms are but briefly described, and no pathogenic properties mentioned.

In looking over the results of this work it appears that no constant form was found, hence no specific plant; that several of the forms when fed to animals were followed by death, in one exceptional case by diarrhœa. No pathological changes were found, but the plants were found in the organs. These results are very perplexing, and, like Booker, the writer is unable to draw any conclusions from them; they do not seem to have any close connection with summer diarrhœa. The results of the various forms of inoculation seem to point to pure septicæmia as defined by Koch. That pathogenic forms were found is not remarkable, since both bacillus lactis aërogenes and Brieger's bacillus, under like conditions, cause death with massive lesions of the intestines.

Lastly, Baginsky * describes a dissolving form as constant in summer diarrhœa. His description is of the briefest, but gives certain peculiar characters which render it possible to affirm that Booker did not find it in his eighteen cases, nor the writer in his, with one possible exception. It is therefore clear that this is not a specific form. No experiments on animals are given.

My own experiments and work have been conducted on much the same lines as those of Booker,—that is, as many forms as possible were isolated from the fæces of infants sick with summer diarrhœa, and a few cases of adult diarrhœa for the sake of comparison ; also the results from some of my experiments on animals are included. My experiments on animals have been confined to subcutaneous injections in guinea-pigs, to assist in determining the species of bacteria, and feeding experiments on cats.

All the species isolated have been worked out on a common schedule and together, so as to allow actual comparison under the same conditions. With few exceptions it has been impossible to connect the forms found with those described by other authors. My cultures were derived from the freshly-passed fæces, not from the rectum ; no material was attainable where this could be done, and so a certain amount of contamination doubtless occurred. But since bacteria take time to grow, and the material for planting was taken from the inner parts, not the surface of the fæces, the proportion of foreign bacteria must have been very small,—so small as to render it doubtful if one was found.

The portions of fæces used were mixed with distilled water steamed for an hour on three successive days. From this a second dilution was made and various quantities sown in gelatin. Glass dishes, covered by a glass slab, were used for the plate cultures instead of the old glass slabs, as being less liable to contamination, and doing away with the complicated ice-dish and level. In these the colonies were studied, and any distinct forms planted in gelatin tubes, and from these new plates made to insure pure cultures. Besides a certain number

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* Baginsky, *Deutsche Med. Wochensch.*, 1888, No. 20.

of colonies, easily distinguished on the plates, there was in most cases a large remaining number of small spheres in the gelatin, pin-head growths on the surface, and small white blotches, of about the volume of the pin-head spots, but flatter. These could not be distinguished one from another by any gross or microscopic study; but deeming it improbable that all were one form, eight or ten test-tubes were inoculated from as many colonies, in the hope of later finding distinctions. Each set of plates was treated in the same way, and all the test-tube cultures made kept until all the cases had been examined. This gave me some two hundred cultures, which were then carried through on potato in test-tubes, on agar-agar, and form and motion noted. They were then divided into species, any constant difference being accepted as proof of a species, and a type of each species being selected, the rest were discarded. With these types other biological characters were studied, as recorded below. Of the thirty-two tentative species two proved to be identical, giving me thirty-one species in all.

Contrary to Macfadyen's experience and my own expectation, a large number of plates kept in hydrogen failed to develop any species not found in those exposed to the air. Being very laborious and impossible for a large series, the method was later given up. At this time neither my method nor the pyrogallic acid method were known.

Many of the forms below described as distinct species give cultures just alike on one or more media, and vary from time to time on different lots of the same medium. For instance, the shape of the head was found to vary in the gelatin cultures, not only with the dryness of the surface, but also with the glistening coat so often seen there. Were this coat absent, a flat circular head would be formed on moist gelatin, an elevated one on dry; given the coat, the bacteria would often grow along the spaces between the flakes, and thus produce the so-called mesentery head. The development of the shaft was found much more constant in form, but the characters of potato cultures gave better results than any other medium tried.

Besides the ordinary methods of culture, certain others were used. These were milk colored purple with a solution of litmus, to note the change of reaction alkaline or acid; potato cultures in test-tubes grown without oxygen according to the pyrogallic method of Buchner; small disks of white of egg in distilled water; and gelatin, gelatin plus 1.5 per cent. milk-sugar, and gelatin plus 1.5 per cent. beet-sugar, over mercury.

All cultures were made at the temperature of the laboratory,—from 60° to 70° F.

The lenses used were from Hartnack, all fine work being done with an eighteenth homogeneous immersion and a complete set of eye-pieces.

BACILLUS A.

Form.—On gelatin and potato, varying from very short bacteria, almost micrococci, to short yet distinct bacteria with a tendency to the diplo form. Size .6 x 1 to .7 x 1.25 μ.

Motion.—None observed.

Stains easily with any of the aniline dyes.

Plate cultures.—Forms small white or yellow-white, limited spots, at times bead-like in form, at times flat.

Gelatin.—Not dissolving; color white; head irregular, variable, rather thick, covering from half to three-quarters of the surface in old cultures; shaft not very strong, uniform or beaded, extending to full depth of inoculation with no special tendency to form a terminal bulb.

Agar-agar.—White, soft, rather thick, glistening growth, limited by line of inoculation and line of contact with the condensation water. Heavy white sediment at the bottom of the latter.

Potato.—Thick, viscid, shining, light, *café-au-lait*-colored growth, slowly spreading over potato. Condensation water clear.

Potato without oxygen.—Only a poor white growth at the end of seven days.

Milk.—No visible change at the end of fifteen days.

Milk and litmus.—Third day, blue changed to red color; ninth day, surface still red; rest with only faintest trace of pink; no curds.

Gelatin and milk-sugar over mercury.—Growth good; much gas evolved.

Gelatin and beet-sugar over mercury.—Growth good; but a moderate amount of gas evolved.

Gelatin.—Growth good.

White of egg.—Water clear at end of three weeks.

Bacillus A found in four cases of summer complaint and in one case of diarrhœa in adult. Large numbers introduced by syringe had no effect on a guinea-pig.

YEAST B.

Form.—A yeast-plant. The single cells spherical from 1.5 to 3 μ in diameter. In budding the bud is connected with the mother cell by a fine, short stalk.

Motion.—None observed.

Stains well with aniline dyes and hæmatoxylon.

Plates.—Appears on the surface as snow-white beads.

Gelatin.—Pure white; head rather thick, fairly extensive; shaft not strong; beaded. After a few days the gelatin dissolves from above down, giving finally a white, dry, sandy-looking coat on surface, a clear fluid, and a white sediment.

Agar-agar.—A white, thick growth, looking like a streak of tallow, limited to the line of inoculation, and a thin, paper-like coat on surface of condensation water.

Potato.—Whitish, dry, thick growth spreading over potato; condensation water clear.

Potato without oxygen.—Same, but poorly developed.

Milk.—Nothing to be noted at end of fifteen days.

Milk and litmus.—Blue color slowly fades.

Milk-sugar.—No growth at end of two weeks.

Beet-sugar.—No growth at end of two weeks.

White of egg.—Water clear at end of three weeks.

This plant was found but once,—in a case of chronic diarrhœa in an adult,—but then in large numbers.

BACILLUS C.

Form.—Bacillus very small and slim, .3 to .4 μ broad, 1 to 1.50 μ long; ends not square. No tendency to form threads noted. Many are almost micrococci.

Motion.—Shoots actively about in all directions, but does not travel much.

Stains slowly and lightly.

Plates.—Colonies rapidly dissolving the gelatin and forming small pools, the size of a cent or larger, extending to the glass below; fluid clear, at times signs of green fluorescence.

Gelatin.—Strongly green fluorescing; dissolving. Dissolves rapidly from upper part of shaft and surface, thus at first forming an irregular shallow funnel; later the funnel spreads, and gelatin is dissolved from above down in a horizontal plane. Fluid clear with flocculi; no coat; abundant white sediment. The lower part of the shaft develops slowly as a white line, to be seen in the solid gelatin in the lower part of the tube. Ultimately all the gelatin dissolves, and the fluorescence disappears, leaving the dissolved gelatin watery, of a clear urine color.

Agar-agar.—Grows as a thin white band along line of inoculation. Agar-agar green fluorescent. Condensation water cloudy, with white sediment.

Potato.—Growth strong, of a clear brown or reddish horn color; viscid; looks sticky; does not flow; covers whole of potato. Condensation water clear.

Potato without oxygen.—Growth same in nature, but much slower and lighter colored.

Milk.—Third day no change; from the fourth day on slowly curdling; curd solid in one mass.

Milk and litmus.—Third day red; by the ninth day white; curd as above.

Milk-sugar.—Third day good growth; fair amount of gas-bubbles in gelatin; first signs of dissolving.

Beet-sugar.—Growth good; gelatin dissolved; by the sixth day a zone of gas one-fourth inch thick between gelatin and mercury.

Gelatin.—Undoubted growth, but very slowly; no gas formed.

White of egg.—A white cloud begins to form on about the sixth day in the lower part of the fluid.

This form was found but once,—in a case of chronic diarrhœa of an adult. Large numbers had no effect on a guinea-pig.

BACILLUS D.

Form.—Very small, short bacteria, .5 μ broad and 1 μ long, ends rounded.

Motion.—None noted.

Stains easily and well.

Plates.—Colonies appear as small white beads or flat round patches.

Gelatin.—Color dull white ; head thin, wrinkled like the growth of bacillus acidum butyricum on agar-agar ; shaft strong, leafed, and beaded, often with a terminal bulb. Bubbles may appear in the gelatin.

Agar-agar.—Grows as a narrow, thin, white, smooth, dry band along line of inoculation.

Potato.—Growth profuse, thick, slowly spreading, resembling partly-dried pea puré in color and appearance.

Potato without oxygen.—Growth fair in quantity, of a yellowish-white color.

Milk.—No visible change by the fifteenth day.

Milk and litmus.—Milk quickly turns red, and then slowly bleaches.

Milk-sugar.—Growth strong; gelatin torn up by the gas; by the third day an inch of gas above mercury.

Beet-sugar.—The same.

Gelatin.—Growth good ; no gas noted.

White of egg.—No change at the end of three weeks.

Only found in one case of diarrhœa in an adult..

BACILLUS E.

Form.—Short bacilli mostly in twos, ends rounded ; single bacilli often oval. .5 x 1 to .7 x 2 μ. Many micrococcus-like.

Motion.—None noted.

Stains readily.

Plates.—Colonies appear as small, white, soft, elevated spots, beginning to dissolve from the fifth to seventh day.

Gelatin.—Slowly dissolving in the form of a narrow, deep funnel. Heavy, dead-white coat on the surface; fluid thick, viscid; a whitish sediment at the bottom.

Agar-agar.—A profuse, solid, white, transparent growth ; sediment in condensation water.

Potato.—A thick pus-colored growth, moist and glistening except at the upper part; this with a wrinkled frill. Condensation water cloudy. Later the growth becomes whitish and almost fills up the lower part of the test-tube.

Potato without oxygen.—Growth same as above.

Milk.—No visible change produced in fifteen days.

Milk and litmus.—The blue color slowly fades from the second day on; does not change to red.

Milk-sugar.—Growth good; no gas; no signs of dissolving. On seventh day mercury allowed to escape; in three days gelatin dissolved.

Beet-sugar—Same as in milk-sugar.

Gelatin.—No more growth than might be attributed to the oxygen in the gelatin; on being exposed to the air the culture flourished.

White of egg.—Still clear at the end of three weeks.

This bacillus was only found in one case of diarrhœa in an adult, but formed a feature of the plates in this case.

BACILLUS F.

Form.—Bacteria .5 to .6 μ wide and of varying length, some of the single individuals being .75 μ long, others up to 10 μ. Longer threads occur, but they are divided into segments. The species is one of those forms which tend to grow into long threads and then divide.

Motion.—None noted.

Stains deeply and quickly. The very short ones stain only at the ends.

Plates.—The colonies appear as small brownish-white points, soon dissolving the gelatin. The cups thus formed spread slowly.

Gelatin.—Dissolving from surface and shaft in the form of a steep funnel; in older cultures the funnel shape is lost; sediment brownish.

Agar-agar.—Diffuse, thin, light-brown coat heavily heaped on surface of condensation water.

Potato.—Covers the whole surface with a rather dry, deeply-folded, chocolate-colored growth. In six or eight weeks the whole potato seems to be transformed into the growth.

Potato without oxygen.—Growth slower and with much less brown color.

Milk.—Curds formed at about the fifteenth day.

Milk and litmus.—The cream remains blue to the end; the milk slowly bleaches; does not redden; curds formed late.

Milk-sugar.—Growth poor.

Beet-sugar.—By the sixth day good growth; slight traces of gas in the form of bubbles, dissolving.

Gelatin.—Slow growth, dissolving; no bubbles.

White of egg.—Clear at the end of three weeks.

This plant was also only found in one case of diarrhœa in an adult, where it formed about ten per cent. of the colonies.

BACILLUS G.

Form.—Distinctly polymorphic, varying from a micrococcus .5 x .5 μ to a bacillus .5 x 2 μ. The round forms tend to appear in fresh gelatin cultures, and the long forms on potatoes, but long and short are often mixed together.

Motion.—Good in the form of lively short excursions.

Stains well; no difference between the long and short individuals.

Plates.—Colonies appear as rather thick, white, roughly-circular blotches.

Gelatin.—White; head dry, limited, thick, at times forming a bead; shaft to bottom fair strength, irregular in contour.

Agar-agar.—Growth as a narrow, thin, smooth, dry band along line of inoculation; exactly like Bacillus B, except for a distinct trace of yellow.

Potato.—Growth abundant, diffuse, soft, fluid with trace of yellow color; condensation water thick, owing to the culture flowing down.

Potato without oxygen.—Growth of same nature as in air, but poor and white.

Milk.—No visible change at end of fifteen days.

Milk and litmus.—By the third day blue color changed to red, from which time on the color slowly fades.

Milk-sugar.—Growth strong; many bubbles in the gelatin, and a volume of gas above mercury.

Beet-sugar.—Growth the same, but gas evolved at least fifty per cent. faster.

Gelatin.—Growth good ; a little gas appeared on the sixth day.

White of egg.—No change in three weeks.

Found in ten of the twenty-two cases of summer diarrhœa, in a kitten with summer diarrhœa, and in two of the experiment cats. It had no effect when introduced by a syringe into guinea-pigs.

BACILLUS H.

Form.—In gelatin, small, stout bacteria .6 x 1 μ, mostly in pairs; on potato, 1.5 to 2 μ, and a little slimmer; in water with white of egg, stout and long up to 3.5 μ, but still many of the short forms.

Motion.—Swims about at a slow pace; no sudden erratic darting observed.

Stains well.

Plates.—Colonies dissolving, forming round, steep-edged, clear cups. No fluorescence noted in two days.

Gelatin.—Dissolves from the surface and upper part of shaft, forming first a cup and then working down from above; at times a sandy surface coat; sediment abundant. About the third day a trace of green color appears, which slowly increases to a beautiful emerald color, and then turns to dull green.

Agar-agar.—Growth as a greenish-white, thin, dry layer, spreading but little; surface with a metallic appearance (thin film). Condensation water covered with a yellowish-white coherent coat. The substance of the agar-agar with the same green-blue fluorescence produced by bacillus pyocyaneus.

Potato.—Growth at first thin, white, with the same metallic appearance seen on agar-agar cultures. Later the culture spreads all over the surface, and potato, culture and all, turning green, assumes the appearance of a mass of spinach.

Potato without oxygen.—Growth the same as in air, except less green color.

Milk.—Milk separated into a small curd and much clear yellow whey by the seventh day.

Milk and litmus.—Same as above, except the curd is blue.

Milk-sugar.—Faint increase in first two days.

Beet-sugar.—Steady progressive growth, gelatin dissolved, and a few small bubbles appearing.

White of egg.—Water slowly becomes cloudy from below up.

Found in fair numbers in one case of summer diarrhœa.

MICROCOCCUS I.

Form.—True micrococci under .5 μ in diameter, with but slight differences between the individuals.

Motion.—None observed.

Stains well.

Plates.—Colonies appear as simple white spots.

Gelatin.—Growth white; head thin, finely sculptured, covering most of surface, later tending to heap up in the centre; shaft slight, tapering a little, hairy. The gelatin becomes soft and sticky, but does not dissolve.

Agar-agar.—Growth as a soft, white, glistening, semi-transparent band along line of inoculation.

Potato.—Growth slight, dirty yellow, dry, finely nodulated, spreading but little.

Potato without oxygen.—No growth.

Milk.—No visible change.

Milk and litmus.—No visible change in three weeks.

Milk-sugar.—No growth.

Beet-sugar.—No growth.

White of egg.—Clear at the end of three weeks.

Found in one case of summer diarrhœa and in a kitten with cholera infantum.

MICROCOCCUS OVALIS.—ESCHERICH.

Form.—Small-sized micrococci; also larger elliptical forms with transverse line of division. Micrococci .3 μ in diameter; elliptical form .3 x .5 μ.

Motion.—None.

Stains well.

Plates.—Small white spheres in the gelatin.

Gelatin.—Growth white; head absent, or a mere trace; shaft very strong, extending undiminished to the bottom. In cultures two or three months old the gelatin is liable to dissolve about the shaft and let it fall in a mass to the bottom.

Agar-agar.—Growth appears as a few thin, small, tallow-like spots, soon ceasing to increase in size.

Potato.—A few minute white points.

Potato without oxygen.—No growth could be seen.

Milk.—No visible change in fifteen days.

Milk and litmus.—Blue color, bleaching very rapidly from below up, with no trace of red; no other change observed.

Milk-sugar.—Growth same as in air, except for the formation of a thin head above the mercury; no gas developed.

Beet-sugar.—Just the same.

Gelatin.—Just the same.

White of egg.—Still clear at end of three weeks.

Found in but one case of summer diarrhœa.

STREPTOCOCCUS COLI BREVIS.—ESCHERICH.

Form.—Little micrococci, .5 μ or under in diameter; at times in short chains, then the individuals broader than long.

Motion.—None noted.

Stains well.

Plates.—Colonies dissolving, forming narrow, steep cups, with a heavy growth of a tawny color.

Gelatin.—Growth white; gelatin dissolving uniformly from the shaft as an axis, thus producing a cylinder of dissolved gelatin surrounded by a hollow cylinder of clear solid gelatin. Fluid cloudy, but little sediment until active growth has stopped.

Agar-agar.—Appears as a very thin, white, transparent growth.

Potato.—Nothing visible in eleven days.

Potato without oxygen.—Nothing visible in seven days.

Milk.—Voluminous curd and clear whey formed in three days; later the curd from above down develops a light rose color.

Milk and litmus.—Blue color rapidly fading; same phenomena as above developing.

Milk-sugar.—Growth as in air; no gas in five days.

Beet-sugar.—Growth as in air; a few bubbles in six days.

Gelatin.—Growth as in air.

White of egg.—Clear at the end of three weeks.

Found in six cases of summer diarrhœa and one case of diarrhœa in an adult. Had no effect on a guinea-pig.

BACILLUS J.

Form.—Polymorphic, varying from micrococci .6 μ to well-shaped bacilli .5 x 1.5 μ. Bacilli occur chiefly in the old cultures.

Motion.—None observed.

Stains.—The micrococcus form stains deeper than the bacillus form.

Plates.—The colonies appear as small white beads or blotches, with nothing characteristic about them.

Gelatin.—Culture white; head limited, tending to form a bead; looks soft, yet glassy; shaft strong, often with a terminal knob. Bubbles are apt to appear in the gelatin of old cultures.

Agar-agar.—Culture forms a thin, white, transparent band.

Potato.—Culture spreading but little, thick, of a faint, brownish-yellow color; condensation water clear, with a heavy white sediment.

Potato without oxygen.—Growth same, but white.

Milk.—No visible change at the end of fifteen days.

Milk and litmus.—Blue changed to red on the second day; then slowly bleaches from below up.

Milk-sugar.—Growth good; gas formed by third day.

Beet-sugar.—Growth good; gas formed by third day.

Gelatin.—Growth good; no gas formed by fifth day.

White of egg.—Fluid still clear at end of third week.

Found in only one case of summer diarrhœa, then in numbers, some forty per cent.

BACILLUS K.

Form.—Short bacilli .5 to .6 μ broad and 1 to 2 μ long, mostly 1.25 μ long; some a trifle larger in potato cultures.

Motion.—None observed.

Stains well.

Plates.—Colonies appear as white beads or irregularly circular blotches.

Gelatin.—Culture white; head of the mesentery type, or circular and leaf-like, thin, dry looking; shaft finely nodular, good to the bottom.

Agar-agar.—Culture thick, china white, looks soft, and has a tendency to spread over surface.

Potato.—Culture slowly spreading, no rapid growth; at first white, but with age acquiring a faint tawny color; surface inclined to rise in undulations; condensation water clear.

Potato without oxygen.—Growth of same nature, but white.

Milk.—No visible change in fifteen days.

Milk and litmus.—Blue changed to red in two days; then slowly bleaches from below up.

Milk-sugar.—Strong growth; but little gas.

Beet-sugar.—Strong growth; but little gas.

Gelatin.—Growth fair; gas not observed.

White of egg.—No change in three weeks.

Found in eleven cases of summer diarrhœa and one case of diarrhœa in adult, always in large numbers; once as a pure culture. Had no effect on a guinea-pig.

BACILLUS L.

Form.—Mostly diplo-bacilli; a few single ones, .4 x 1.25 μ.

Motion.—None observed.

Stains well.

Plates.—White, clear, rapidly-extending cups, often with a central mass.

Gelatin.—Culture white, rapidly dissolving from both surface and shaft, thus causing an irregular funnel. Upper part of fluid cloudy, rest clear, with snow-like flocculi; heavy white sediment.

Agar-agar—Culture forms a soft-looking china-white tract along centre of surface.

Potato.—Whole of potato shortly covered with a thin, mottled, yellowish-white coat; condensation water thick, with a scum and bubbles on the surface.

Potato without oxygen.—Culture same, except no bubbles seen.

Milk.—Loose curds formed in the second week.

Milk and litmus.—Blue color fades out; does not turn red.

Milk-sugar.—Growth strong, gelatin dissolving more slowly than in the air; a few bubbles.

Beet-sugar.—Same.

Gelatin.—Growth occurs, but less than with the sugars.

White of egg.—No change in three weeks.

Found in three cases of summer diarrhœa, once the only form found, and in three kittens.

BACILLUS M.

Form.—Regular, slim, small bacilli, .3 x 1 μ.

Motion.—None observed.

Stains poorly.

Plates.—Colonies appear as rather large, irregular, white, elevated spots, surrounded by a green fluorescing halo.

Gelatin.—Culture white; gelatin of fresh cultures grass-green fluorescing; head extensive, flat, covered with little knobs; at times forms curious geometrical figures; shaft poor, but extending to bottom.

Agar-agar.—Culture white, fairly thick, sculptured, tending to spread; substance of agar-agar, at first green fluorescing, then yellowish.

Potato.—Growth whity-yellow, limited on the upper dry part, diffuse and abundant on the lower part.

Potato without oxygen.—Only poor growth.

Milk.—Begins to curd in a few days.

Milk and litmus.—Color slowly fades; does not turn red.

Milk-sugar.—Growth fair; no gas.

Beet-sugar.—Same.

Gelatin.—Merest trace of growth.

White of egg.—Water slowly becomes cloudy.

Found in one case of summer diarrhœa, in one case of diarrhœa in adult, in one experiment kitten, to which it had been fed, and in another experiment kitten. Had no effect on guinea-pig.

BACILLUS N.

Form.—Bacilli .5 x 2 to .5 x 4 μ, often in short chains, ends round; individuals at times more or less curved.

Motion.—Active, fish-like.

Stains well.

Plates.—Colonies dissolving, forming broad, shallow surface pools, with a white surface coat.

Gelatin.—Culture white; dissolving the gelatin in the form of a broad, shallow cup, or saucer-like; then, from above down, the dissolved gelatin is unusually clear and covered on the surface with a coat not unlike a layer of coagulated albumen. In old cultures a slight sediment is formed. The shaft below the cup grows slightly, is shadow-like, and does not dissolve.

Agar-agar.—Forms a very thin, transparent coat over whole surface.

Potato.—In three days nearly the whole surface is covered with a thin, dry, yellow, wrinkled coat; surface of condensation water the same.

Potato without oxygen.—Culture the same, except yellow color less pronounced.

Milk.—No visible change occurred in fifteen days.

Milk and litmus.—The blue color began promptly to bleach throughout and was all gone in eight days.

Milk-sugar.—Growth slow, limited, but undoubted; the characters of an air culture developing on a much smaller scale.

Beet-sugar.—Two efforts failed.

White of egg.—Fluid soon becomes cloudy.

Found in one case of summer diarrhœa and one of diarrhœa in an adult.

BACILLUS O.

Form.—Short square-ended bacteria, .4 to .5 μ broad and 1 to 1.5 long, in chains of thirty or more, the clear spaces long up to .8 μ.

Motion.—Swim along with a resemblance to a snake; no corkscrew (spiral) motion could be made out.

Stains beautifully clear with any of the basic aniline dyes in water.

Plates.—Cultures dissolving, forming broad, shallow, rapidly-growing pools; fluid cloudy, often with a small ball of sediment in the centre.

Gelatin.—Gelatin rapidly dissolving from both surface and shaft in no definite or fairly constant form. Fluid clear with coarse white flocculi both top and bottom.

Agar-agar.—Culture forms a white, soft, running growth.

Potato.—For some time the culture forms an almost invisible white growth much resembling cultures of the typhoid-fever bacillus. Old cultures are more distinct; the condensation water clear, with at times a few bubbles.

Potato without oxygen.—Growth the same.

Milk.—Milk begins to curd on the third day; serum clear; the curd is in one mass and cheese-like.

Milk and litmus.—No change in three days, then slow bleaching; no red seen at any time.

Milk-sugar.—Growth less rapid than in air, but pronounced; gas-bubbles to about fifteen cubic centimetres formed in seven days.

Beet-sugar.—Growth decidedly stronger; gas to about eight cubic centimetres formed in the first week.

Gelatin.—Growth same as with milk-sugar.

White of egg.—No change in three weeks.

Found in two cases of summer diarrhœa and in three of my experiment kittens, once as pure culture.

BACILLUS P.

Form.—Small bacilli .4 x .1 μ with a tendency to form micrococci .6 x .5 μ in old cultures, as a degeneration form.

Motion.—None observed.

Stains well; the micrococcus form deepest.

Plates.—Cultures appear mostly as small white spots, but some spread over surface.

Gelatin.—Growth abundant, white; head tends to be of the mesentery type; shaft strong to bottom.

Agar-agar.—Culture forms a thin, dry, smooth, white, enamel-like band along line of inoculation.

Potato.—Growth good, dry, diffuse; upper dryer parts dirty brownish, lower parts buffy.

Potato without oxygen.—Growth good; white, containing a few bubbles.

Milk.—No visible change in fifteen days.

Milk and litmus.—The blue color quickly begins to bleach and turns red at the same time.

Milk-sugar.—No growth; controls in air grew well.

Beet-sugar.—Growth good; about two cubic centimetres of gas formed in the first week.

White of egg.—No change in three weeks.

Found in two cases of summer diarrhœa.

MICROCOCCUS Q.

Form.—Only true micrococci .5 to .75 μ in diameter observed.

Motion.—None observed.

Stains well.

Plates.—Colonies form the white spots and beads so often mentioned, with nothing peculiar.

Gelatin.—Culture white; head flat, good sized, dry, knobbed, and concentrically lined; shaft strong, beaded, often surrounded with bubbles.

Agar-agar.—Culture forms a simple china-white line.

Potato.—Growth never abundant; generally formed white beads; at times these would run together to form a soft white mass.

Potato without oxygen.—Growth, if anything, better than in the air; gas-bubbles in the culture.

Milk.—No true curds in fifteen days; cream raised up by gas in three days; old cultures seem to effervesce if shaken slightly.

Milk and litmus.—Blue changed to red in three days; red then bleaches; other characters same as in milk.

Milk-sugar.—Growth good; gas formed at the rate of about five cubic centimetres a day.

Beet-sugar.—Growth good; gas formed at the rate of eight or ten cubic centimetres a day, and mercury soon all expelled.

Gelatin—Growth fair, but no gas formed in five days.

White of egg.—No change in three weeks.

Found in one case of summer diarrhœa as a pure culture in vast numbers.

MICROCOCCUS R.

Form.—Large micrococci; 1 to 1.3 μ in diameter.

Motion.—None observed.

Stains well, but viscous coat often confusing.

Plates.—Colonies form white, viscid patches, which will come up in one piece.

Gelatin.—Growth white; head broad and thick, viscid, edge scalloped, even; surface veined like a peltate leaf; shaft a trace only.

Agar-agar.—Culture forms a soft china-white, viscid line.

Potato.—By the eleventh day a very meagre, almost invisible, white growth, which could not be surely recognized by the eye.

Potato without oxygen.—No growth.

Milk.—No visible change in fifteen days.

Milk and litmus.—No visible change in fifteen days.

Milk-sugar.—No growth.

Beet-sugar.—No growth.

White of egg.—No change in three weeks.

This plant was found in one case of summer diarrhœa and in the alimentary canal of one of my experiment cats. It has never been seen as a contamination nor found in the laboratory. In both cases it occurred in numbers. Had no effect on a guinea-pig.

BACILLUS S.

Form.—On gelatin very short bacilli, .4 x .8 to 1 μ; on potato longer up to 3 μ.

Motion.—None observed.

Stains well.

Plates.—Colonies tend to form white, irregular blotches.

Gelatin.—Culture dull white; head extensive, soft, thick; border irregular with many processes, at times even; shaft strong to bottom. Gelatin tends to split.

Agar-agar.—Culture forms a soft, thick, china-white coat, spreading over the whole surface.

Potato.—Growth abundant, diffuse, at first china white, soft; fluid, thick, dirty white. In old cultures a buffy shade appears, and the bottom of the test-tube appears as if filled with whitish pus.

Potato without oxygen.—Growth strong, literally blown up with bubbles, which vanish a few days after the admission of oxygen.

Milk.—No visible change in fifteen days.

Milk and litmus.—Blue changed to red; red then bleaches.

Milk-sugar.—Growth and formation of gas both moderate.

Beet-sugar.—Growth good; gas excessive.

Gelatin.—Growth fair; no gas in five days.

White of egg.—No change in three weeks.

Found in four cases of summer diarrhœa. Had no effect on a guinea-pig.

SPIRILLIUM T.

Form.—Curved bacteria .5 x 1.2 μ, forming chains to six segments; round-ended if separate; nearly square-ended in the chains.

Motion.—Shoot about in an erratic, lively way.

Stains fairly well.

Plates.—Colonies form small, round, clear cups, with little sediment.

Gelatin.—Gelatin dissolving in the shape of a long, narrow funnel; fluid cloudy; a slight but undoubted green fluorescence exists; old culture, dissolved gelatin, yellow; and thick white sediment.

Agar-agar.—Culture forms a yellow-white, soft, semi-transparent coat, tending to flow.

Potato.—Culture forms a profuse, soft, flowing coat; at first of a light brownish-yellow, later, at times, of a deep flesh color; surface of condensation water covered by the same, raised up by bubbles.

Potato without oxygen.—Growth the same.

Milk.—No visible change in fifteen days.

Milk and litmus.—No change in three days; later the blue color gives place to a light gray, not observed in cultures of other species, which bleached the litmus.

Milk-sugar.—Growth good; gelatin dissolved; much gas formed; no fluorescence noted.

Beet-sugar.—Growth same; fluorescence noted.

Gelatin.—Limited growth only; no gas.

White of egg.—No change in three weeks.

Found in one case of summer diarrhœa in good numbers, and one of the kittens with cholera infantum.

BACILLUS U.

Form.—A very even-looking small bacillus, .2 x 5 μ to .3 x 1 μ, with well-rounded ends; often in chains of from two to four.

Motion.—None observed.

Stains the slowest of all the species noted.

Plates.—Colonies form small white dots.

Gelatin.—Culture of a creamy tint, not unlike that of true Brieger's bacillus; head usually of the mesentery type; in time fairly thick; shaft strong, uniform to the bottom, but no bulb. A halo appears about the shaft of old cultures.

Agar-agar.—Culture forms on the top part a white, transparent, thin line; the lower more moist parts covered with a thin, opalescent, white coat.

Potato.—Culture forms a soft, rather thin, faintly-yellowish growth; condensation water clear, with bubbles.

Potato without oxygen.—Growth same; white.

Milk.—No visible change in fifteen days.

Milk and litmus.—Blue color slowly fades.

Milk-sugar.—Growth good; a few gas-bubbles.

Beet-sugar.—Growth good; bubbles larger.

Gelatin.—Growth good; no bubbles in five days.

White of egg.—No change in three weeks.

Found in one case of summer diarrhœa, one experiment kitten, and both of the cholera infantum kittens.

BACILLUS V.

Form.—Irregular; apparently partly-degenerated bacilli; look like pieces of root. 1 x 5 μ.

Motion.—None observed.

Stains readily.

Plates.—Cultures dissolving, forming slanting cups, with clear fluid and a light greenish-yellow surface-coat. The deep colonies appeared as yellow balls.

Gelatin.—Culture yellow; gelatin dissolved from top down; no trace of shaft. Fluid yellow, with an upper yellowish coat and an abundant yellow sediment.

Agar-agar.—Culture forms a rather soft, thick, slowly-spreading lemon-yellow mass.

Potato.—Growth is rapid, and in a day spreads over the whole of the inoculated surface. The culture forms a soft, glistering, thick, sulphur-yellow coat; the condensation water is covered with the same.

Potato without oxygen.—No growth occurred.

Milk.—The milk remains unaltered, but a sulphur-yellow growth forms on the surface of the cream.

Milk and litmus.—Blue fades; does not change to red.

Milk-sugar.—No growth in seven days.

Beet-sugar.—No growth in seven days.

White of egg.—Becomes cloudy in the course of a week.

Found in four cases of summer diarrhœa, always in fair numbers, and one case of diarrhœa in an adult. Had no effect on a guinea-pig.

BACILLUS W.

Form.—A straight, round-ended bacillus, .5 μ broad and 1 to 2 μ long; often in twos.

Motion.—None observed.

Stains well.

Plates.—Cultures appear as small yellowish balls, with short projecting hairs, on surface a narrow band of dissolved, clear gelatin about them.

Gelatin.—Young growth white, old yellow; gelatin dissolving from above down; fluid cloudy; heavy sediment; shaft not dissolving till late; finally granular to the bottom.

Agar-agar.—Culture mottled with semi-transparent spots, pure yellow in color, soft and flowing.

Potato.—Culture is slow to grow, but ultimately forms a thin, transparent, fluid, dirty-yellow coat over the whole potato.

Potato without oxygen.—Growth good, but more brown in color.

Milk.—Milk divided into a cloudy whey and a few small curds or flocculi.

Milk and litmus.—Blue does not fade or alter, but a few flocculi appear at the bottom, and a blue cloudy whey above; if undisturbed, a clear zone just below the cream.

Milk-sugar.—No growth in seven days.

Beet-sugar.—No growth in seven days.

White of egg.—In a few days the bottom of the tube becomes filled with a dense white cloud, which gives the impression of the white of egg being dissolved.

Found in six cases of summer diarrhœa and in both the cholera infantum kittens. Had no effect on a guinea-pig.

BACILLUS X.

Form.—Uniform; little bacilli .3 x 1 μ.

Motion.—None observed.

Stains well.

Plates.—Colonies form small yellowish-white beads and blotches.

Gelatin.—Growth white or buffy; head smooth, thick, viscid, good-sized, with an open pit or crater over the shaft; shaft very strong, with leaf-like processes. Close examination shows that the crater is in connection with a tube following the line of inoculation; a veritable scape-vent for gas.

Agar-agar.—Culture forms a soft, opaque, narrow line down centre, with bubbles in condensation water.

Potato.—Culture forms an abundant white, thick, semi-transparent growth. Condensation water thick and cloudy.

Potato without oxygen.—Growth good, with many bubbles.

Milk.—No visible change in fifteen days.

Milk and litmus.—Blue changed to red, then bleached from below up; gas formed, but no curds.

Milk-sugar.—Growth good; many bubbles and much gas.

Beet-sugar.—Same, except gas not quite so abundant.

Gelatin.—Growth good; much gas formed.

White of egg.—Clouds are formed.

Only found in one case of summer diarrhœa occurring late in the season; then pure in large numbers. Had no decided effect on a guinea-pig.

MICROCOCCUS Y.

Form.—Occurs as micro- and diplococci .5 μ in diameter; at times does not divide, then a bacillus .5 x 1 μ formed.

Motion.—None observed.

Stains well.

Plates.—Colonies appear as small beads and flatter blotches.

Gelatin.—Growth white; head limited, thin, dry; shaft at times simple, but often forming balls all the way to the bottom. Signs of gas.

Agar-agar.—Culture forms a very narrow, thin, white line.

Potato.—Culture forms a limited, soft, transparent, white growth not easy to see when looked at from in front.

Milk.—No visible change in fifteen days.

Milk and litmus.—Blue faded in old cultures; no other change.

Milk-sugar.—Growth good, with a good volume of gas.

Beet-sugar.—Same as above.

Gelatin.—Growth fair, decidedly less than with the sugars; gas also less.

White of egg.—No change in three weeks.

Found in one case of summer diarrhœa. Had no effect on a guinea-pig.

BACILLUS Z.

Form.—A bacillus 1 x 3 μ on gelatin, 1 x 2 to 1 x 8 μ on potato, also chains with segments 2 μ long.

Motion.—None observed.

Stains well.

Plates.—Colonies form the small white beads or flatter spots.

Gelatin.—Growth white; head of the mesentery type, or extending by distinct branches; at times thin, with an even border; shaft strong to the bottom.

Agar-agar.—Culture forms a narrow, white, semi-transparent band.

Potato.—Growth of culture good; the upper part tending to dry and form a clear brown color, the lower more moist parts yellow brown. Condensation moisture very thick, at times depositing some black substance on the surface of the test-tube.

Potato without oxygen.—Growth same; culture white; no black deposit occurred.

Milk.—No change, except a thickening of the bottom, in fifteen days.

Milk and litmus.—Blue changed to red in two days; red then bleaches from below up; later a slight thickening in the bottom occurred, but no true curds.

Milk-sugar.—Growth and gas both fair.

Beet-sugar.—Same.

Gelatin.—Growth fair; no gas.

White of egg.—No change in three weeks.

Found in four cases of summer diarrhœa and one experiment kitten. Had no effect on a guinea-pig.

BACILLUS *a*.

Form.—Uniform slim bacilli, .25 x 1 μ to .35 x 1.4 μ.

Motion.—None observed.

Stains fairly well.

Plates.—Colonies appear as small, flat, circular spots.

Gelatin.—Culture white; head circular, thin, covering whole of surface with a peculiar lustre; shaft extends to bottom, but is slight.

Agar-agar.—Culture forms a white, fairly thick, transparent band.

Potato.—Culture forms but a very slight white, soon-arrested, growth. Condensation water cloudy.

Potato without oxygen.—Growth fair; culture with gas-bubbles.

Milk.—No visible change in fifteen days.

Milk and litmus.—Blue turns to red in three days, then bleaches.

Milk-sugar.—Considerable growth, same as in air, but no gas.

Beet-sugar.—Considerable growth and a few small gas-bubbles.

Gelatin.—Growth fair, and three small bubbles.

White of egg.—Water becomes cloudy.

Found in two experiment cats only. Had no effect on a guinea-pig.

BACILLUS *б*.

Form.—Great lumpy, root-like bacteria of all sorts of forms; only set form a bacillus, .8 x 2 μ; on potato, all of set form.

Motion.—None observed.

Stains very dark.

Plates.—Colonies form small white beads or blotches.

Gelatin.—Growth white or yellow; head covering most of surface, with a leafy border, thin, dry, opaque; shaft very strong.

Agar-agar.—Culture forms a thick, transparent, distinctly yellow band.

Potato.—Culture grows very slowly for a long time as dry beads of a light sulphur color.

Potato without oxygen.—No growth.

Milk.—No change in fifteen days.

Milk and litmus.—No change.

Milk-sugar.—No growth.

Beet-sugar.—No growth.

White of egg.—No change.

Found in only one experiment cat.

Besides the above, a pink sarcina, very common in the air of the laboratory, was found as a single colony in four plates, and a yellow bacillus as a lone colony once. These are ruled out as probably contaminations.

The cases from which the cultures were procured are briefly given below:

CASE I., February 11.—Four months old, breast-fed child; eight to twelve spinach stools a day; slight fever.

CASE II., March 18.—A marasmatic child, eleven weeks old; six to twelve green stools a day; vomiting; collapse: bottle-fed.

CASE III., April 4.—Chronic lienteric diarrhœa in an adult.

CASE IV., April.—Adult, with attack of temporary diarrhœa.

CASE V., July 26.—Infant, eleven months old; breast-fed, with green diarrhœa; fever and prostration.

CASE VI., July 27.—Bottle-fed infant, one month, with green and yellow watery stools; collapse.

CASE VII., July 27.—Bottle-fed infant, five months old; many green and yellow stools and vomiting.

CASE VIII., July 27.—Infant, with green diarrhœa.

CASE IX., August 1.—Bottle-fed infant, five months old, with green diarrhœa, vomiting, fever, and collapse.

Case X., August 14.—Bottle-fed infant, seven months old, with green diarrhœa, vomiting, fever, and collapse.

Case XI., August 14.—Bottle-fed infant, two months old; diarrhœa; grayish curds and water; collapse.

Case XII., August 16.—Infant, one year old, bottle-fed, with frequent spinach and curd stools; no fever or collapse.

Case XIII., August 16.—Same infant as XI.

Case XIV., August 16.—Same infant as XII. The stools contained the striped fibres of meat. Child much sicker.

Case XV., August 18.—Bottle-fed infant, seven months old, with green, watery stools; no fever.

Case XVI., August 18.—Bottle-fed infant; diarrhœa; stools very light, mushy, strongly acid.

Case XVII., August 20.—Bottle-fed infant, two months old, with frequent green stools.

Case XVIII., August 22.—Bottle-fed infant, with clear brown mucus stools.

Case XIX., August 27.—Infant, one month old; Mellin's food; with green and brown stools.

Case XX., August 27.—Infant, bottle-fed, one year and a half old, with slight green diarrhœa.

Case XXI. August 27.—Bottle-fed infant, four months old, with green diarrhœa and partial collapse.

Case XXII., August 27.—Infant, bottle-fed, five months old, with brown and bloody discharges and fever.

Case XXVII., August 28.—Infant, eighteen months old; on mixed diet; diarrhœa; stools green.

Case XXVIII., August 28.—Infant, one month old; on Mellin's food; diarrhœa; stools chiefly green slime.

Below follows a table giving the relations of the various kinds of bacteria to the cases. The simply numbered cases are cases of summer diarrhœa in its ordinary forms; no case of true cholera infantum came to hand. Those marked cholera infantum kittens I. and II. record the results of bacteriological examination of the stomachs and intestines of two kittens which died of cholera infantum. A lot of four kittens, procured for experimental purposes, proved to be too young to feed themselves. They were therefore fed by hand with milk and hot water half and half, at intervals of about three hours. Kittens thus raised usually do well. I know of a child who thus raised fourteen kittens in a summer. After a few days two of the kittens came down with violent purging and vomiting of apparently nothing but water. Their whole bodies shrank, the surface became cold and stiff (sclerema), and they died in two and a half days. The other two quickly followed in the same way.

Careful autopsies with bacteriological examinations were made, as the kittens offered absolutely fresh material,—a want so much felt in the study of autopsies performed on children.

The other reports on cats are taken from some of my experiments, to be described later.

																							Cholera Infantum Kittens.												
Species.	I.	II.	III. sd.	IV. sd.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	int.	st.	st.	int.	XXVII.	XXVIII.	Cat 6.	Cat 7, gut.	Cat 9, gut.	Cat 9, st.	Cat 10, st.	Cat 10, gut.	No. of Cases in which found.
A	×			×	×															×															4
B			×																																1
C			×																																1
St. coli grac.			×								×				×		×		×			×													6
D				×																															1
E				×																															1
F				×																															1
G						×	×	×			×			×			×	×	×				×	×				×	×					×	13
H									×																										1
I										×																×									2
M. ovalis.										×																									1
J											×																								1
K		×	×		×			×	×	×	×	×						×	×		×							×							12
L					×								×					×						×		×			*One Lost*		×	×			7
M			×											×																	×			×	4
N				×										×																					
O	*One Lost*									×				×								×								×			×	×	6
P							×								×																				2
Q																×																			1
R																		×							×										2
S							×										×	×	×																4
T																			×				×												2
U																				×			×			×			×						4
V				×					×								×		×		×														5
W		×				×	×										×			×		×	×		×	×									9
X																											×								1
Y																												×							1
Z									×								×				×							×				×			5
A																															×	×	×	×	4
B																																	×		1
No. in Case.	2	2	5	6	3	2	4	2	4	4	4	1	1	4	2	1	6	5	6	3	3	3	4	2	2	4	1	4	3	1	3	3	3	4	

The first thing to be noted, in looking over the results of the bacteriological investigations, is the absence of both bacillus lactis aërogenes of Escherich and Brieger's bacillus. Booker reports Brieger's as prevalent and is in doubt concerning the other. At least half a dozen of the species described by me might be considered to fill Escherich's description, except that they have no pathogenic effect on guinea-pigs when introduced under the skin. Comparison with cultures of true Brieger's bacillus show this, though very like in growth, to be invariably more of a bacillus and less of a micrococcus than the forms isolated by me, and also more yellow in color. Experiments with true Brieger's produced a most violent attack of diffuse intestinal hemorrhages, followed by death in a few hours. So the failure of the forms isolated by me to act cannot be attributed to technical errors on my part.

While Brieger's bacillus and the lactic acid bacillus of Escherich were not found, a whole group of species in growth, form, and general physiology closely resembling them have been isolated. This group is represented by bacilli A, G, J, K, P, S, Z; they seem to form a genus; the form is very much alike. All are good anaërobic growers; all form gas; all turn milk distinctly acid; and all closely resemble one another in pure cultures. Many would doubtless class these altogether as one species; but if species are to be recognized at all, we must come to recognizing every fixed difference as constituting a species.

This group occurred—always very abundantly—in eighteen out of the twenty-two cases of summer diarrhœa, and is also well represented among the kittens. They are, however, so much like the harmless forms found by Escherich that they may for the present be laid aside as of no specific significance. They are also almost the only forms tested which failed to produce intestinal troubles in kittens. Excluding these, there is no species, or group of species, left either generally occurring or in sufficient numbers to be regarded as the specific pathogenic plant of summer diarrhœa.

Turning from the general figures to the cases, there are four—XII., XIII., XVI., XXVII.—of summer diarrhœa in which only one kind of plant was found,—namely, K, L, Q, and

X. Of these, L being a strongly dissolving species and destroying all the plates except those of high dilutions, it can only be affirmed that the plant formed a large part of all the bacteria present.

The other three cases are not exposed to this difficulty, since neither K, Q, or X dissolve gelatin. We are thus able in these cases to say that out of the many thousand bacteria taken from the stools all were of one kind in each case.

Bacillus K belongs to the large group which probably does not possess any very active pathogenic powers. The case may well be regarded as one of those suggested by Baginsky, where the ordinary forms develop in excess. A few days later, with improper food, as Case XIV., K disappeared and G appeared in its place, with M, N, and O,—M at least being harmful. Cases XI. and XIII. show the same change from the prevalence of common forms in the first of the attack to active forms later.

Bacilli Q and X, on the other hand, are the two most active fermenters isolated, have a great deal of energy, and, if anything, grow better out of than in the air.

Turning to the biological characters of the species, it is worthy of note that most turned the scale towards acidity, though rarely excessively, and all but four have been shown to grow without oxygen on one or more of the three media tried in this way. Of these four, three are decidedly rare species, and might justly be doubted had they not all been taken directly from the intestines of the kittens; the other species, V, was found in five cases of summer diarrhœa in good numbers, which alone makes contamination improbable. As the cultures in the laboratory abound in degeneration forms, my failure to get anaërobic cultures is very likely due to improper conditions, not to the absence of this power.

However suggestive the above facts may be, they do not clearly indicate any special line of causation, in fact might be results only.

To test their powers of producing disease, a series of feeding experiments was started and partly carried through with the expectation of finding one or two specific forms. Old kittens or young cats, four to six months old, were fed on pure cultures of various species grown in milk.

Cats were selected, as they will feed themselves and thrive on milk; young ones, so as to get the digestive canal in as nearly the same state of development as that of the infant as possible. Very young ones were not used, as they are liable to diarrhœa any way.

Milk was used as a medium as being the food of infants. It was always intended to be fed to the cats in a fairly fresh state before curds had begun to form; a few times, however, a sudden rise of temperature brought on curdling before expected.

The kittens were all breast-fed, carefully selected, plump, in fine spirits, and had always done well. They were kept under watch for at least a week—several for six—in the rooms where the experiments were made, and fed on fresh milk from the same source as that used for the cultures. Before the experiments began some had to be shut up in boxes for the sake of room, others were allowed the liberty of the well-ventilated rooms in which they had lived. Those put in boxes were all put under observation for some time, and control experiments with sterile milk made.

The clinical histories given are of necessity short; cats do not, especially when sick, make nice things to handle, nor do the duties of a practising physician leave much spare time. The nature of the stools in the boxes was easily determined; those from the cats at large were collected by putting a box of fresh ashes in the corner of the room to which the cats invariably resorted.

The autopsies were made as soon as possible, mostly in a few hours; the bodies in the meanwhile being kept packed in an ice-house. At the autopsy corrosive sublimate was freely used on the outside and only hot instruments until all the cultures were made. These were made according to Esmarch.

KITTEN I.—Kitten seven weeks old, of good physique, caged, and put on a diet of pure culture of K, two days old, July 14.

July 18.—Still taking pure culture milk of K; fæces softer (?), brown; animal possibly a bit dull. Put on ordinary house milk.

July 21.—Again put on pure culture milk of K, two to three days old, and so fed until the 25th. By this time the kitten was rather bedraggled from being so long closely confined, but showed no sign of being sick. The stools were just the same as when first caged.

August 2.—Kitten found dead in the room.

Autopsy.—Nothing found except a general congestion of intestines, increase of fluid in peritoneum, and a plug of cotton wool one and a half inches above rectum. No ulcerated patches.

KITTEN II.—Healthy, from same litter as No. 1. Caged. Put on house milk of ordinary quality, July 14.

July 18.—Lively; stools much like those of No. 1.

July 21.—More quiet than when put into the box; dirty but well; stools unaltered. Put on sterile milk.

July 25.—Fourth day of sterile milk. Kitten still well; the stools are much lighter in color and have a yellow tinge. Kitten was then released, and, remaining perfectly well, was used in another experiment four weeks later.

KITTEN III.—Healthy, of same litter as No. 1. Caged, and put on a pure milk culture of K, two days old, July 14.

July 18.—Kitten stays most of the time in the corner and does not rouse up if poked. Stools cylindrical, long, dry, dark. Put on house milk.

July 21.—Put on pure culture of K again, two and a half days old.

July 25.—Now has a decided diarrhœa, which began on the 23d. The stools are soft, dark, and increased in numbers.

July 30.—Kitten still has diarrhœa, though at large on house milk since the 25th. It was now ordered house milk with much bicarbonate of soda in it, and in two days the diarrhœa ceased.

KITTEN IV.—Kitten healthy, of same litter as three above. Caged, and put on milk with pure culture of C, two days old, July 14.

July 18.—Kitten looks strong and is active; cries much. Stools altered from the 16th on. Are now brown, offensive, contain considerable mucus, and are as soft as hen-dung. Stools frequent and small. Appetite good. Put on house milk.

July 21.—Diarrhœa has stopped; again put on pure cultures of C, two and a half days old.

July 25.—Kitten soon began to get very rough; diarrhœa began in the night of the 22d. The cat is now distinctly shaky, trembles all over, pupils dilated, and do not contract before a light as do those of the other three cats. Let out and put on house milk.

July 29.—Unbeknown to me, the kitten died last night and was buried. Diarrhœa continued to time of death. Up to this time I had had no idea that any of the kittens would die, and was only looking for a diarrhœa.

KITTEN V.—Healthy, ten weeks old. Caged, and put on a pure milk culture, two days old, of C, August 13.

August 14.—Kitten seems fairly well, but is all dirt behind. Stools numerous, quite soft, varying from very light to yellowish. All the supply of milk having coagulated, kitten was let out and put on house milk.

August 16.—Recaged; diarrhœa stopped; again put on pure culture of C.

August 17.—Has decided diarrhœa same as before.

August 22.—Supply of milk given out; put on house milk. For the last three days no separate stools were to be found in the box; the bottom was simply coated with a layer of fluid manure.

August 26.—The diarrhœa, mostly water, still continues. Kitten let out at large.

KITTEN VI.—Healthy, ten weeks old. Caged, and put on C, August 13.

August 14.—Has diarrhœa; stools soft as in No. 5, but brown, not light or yellow. Let out on house milk.

August 16.—Recaged; no diarrhœa, and put on milk of the first generation, from milk inoculated with a small amount of the stools from Case X. of summer diarrhœa.

August 17.—Diarrhœa has begun; stools rather soft.

August 22.—Kitten has been suffering from a sort of mixed diarrhœa for three days. Some stools hard and dry, others soft with much mucus, and others partly both. Supply of milk has given out. Kitten let out on house milk.

August 26.—Kitten still has diarrhœa; is thin, worn, but moves about quite actively.

September 11.—Diarrhœa has continued, and, rather to my surprise, kitten died to-day.

Autopsy.—But little fat under the skin, muscles pale, lungs and liver light colored but otherwise normal. Stomach full of grumous matter and curds; intestines full of the same and blood; partly broken down but still reddish. Intestines from six inches down to twenty inches very much congested, deep red; the red color all through and through the walls. Below this part intestines swollen and gray colored, with no signs of congestion. Mesenteric glands rather large and very dark (blood?). Peritoneum itself, except over intestines, clear and glistening; contained about two drachms of fluid slightly tinged with blood.

Portions of various organs were placed in absolute alcohol, and later studied.

Lungs normal, except one lobule, which is partly filled with epithelial cells.

Spleen rather full of leucocytes.

Liver normal, except for an increase of small round cells (leucocytes) along the periacinal vessels.

Stomach.—Cells of mucosa clear; nuclei distinct; submucosa and patches along vessels through muscle coat abnormally rich in round cells.

Small intestine.—Mucosa, with quite a number of the goblet cells, full of mucus; in places loss of mucosa, in all probability premortal, as the body was perfectly fresh at autopsy, and the mucous cells on the edges show no, or indistinct and irregular, nuclei. Submucosa thickened with patches of leucocytes. Follicles at valve much enlarged and broken through mucosa into lumen of intestines. Other follicles crowded with leucocytes.

Bacteria. Gram method.—Bacteria in crypts on villi, but not in tissues, except at seat of erosions at valve, of no single form. Lungs, pneumonic spot crowded with micrococci; some single, mostly in two, but a few chains of four. The same plant also in less numbers on the walls of the healthy bronchi. Cultures from intestine gave only G and U.

Summation.—Round-cell infiltration of stomach, intestine, especially follicles, liver, spleen; erosions of follicles, congestion of intestines, hemorrhage into same, and catarrhal pneumonia. The pneumonia may be laid to one side as a very recent complication, leaving an inflammation of the intestines, followed by hemorrhage; the latter, probably, the immediate cause of death.

KITTEN VII.—A good-sized young kitten, healthy and plump. Caged; put on milk with pure culture of E, August 28. Milk two days inoculated; apparently unaltered.

August 30.—Kitten has a decided soft, brown diarrhœa this morning.

August 31.—Diarrhœa has increased, and the animal is clearly feeble.

September 11.—Death occurred early in the day.

Autopsy.—Fair amount of fat under skin and in body. Heart and lungs healthy, stomach containing considerable amount of curdled remains of food; mucosa pale; submucosa swollen.

Intestines almost empty and tightly contracted; pale. Owing to the unusual contraction and consequent mechanical thickening of the various layers, it was not possible to form any accurate opinion as to thickening. No erosions could be seen.

Lymph-glands of mesentery enlarged; gray.

Liver and kidneys appeared normal.

MICROSCOPIC EXAMINATION.

Stomach.—No gross changes to be seen with Hartnack 4 and 2; 7 and 2 show the mucosa intact everywhere; submucosa and muscular coats normal. The cells of the mucosa are decidedly cloudy, and those of the crypts mostly of the delamorphic kind.

Intestines.—Cells cloudy; great numbers of goblet or mucous cells in the upper part of the intestine, diminishing to few or none at the valve. But little change in general submucosa. Follicles enlarged and tightly packed with round cells; in lower part of small intestine breaking through the mucosa and forming erosions.

Bacteria. Gram method.—A few, with safranine; many bacteria in the large intestine, just below valve. These are on the surface, between the villi, in the crypts, in the eroded follicles, and to be traced back to the first lymph-glands. Some of the bacteria appear to be in the cells, others outside them.

Cultures from the intestines showed only O in large numbers, and Z; no trace of E, the form fed, to be found.

Changes found.—Intestines pale, contracted; great increase in goblet cells; swollen and ruptured follicles; bacteria in the same; lymph-glands enlarged.

CAT XIII.—Healthy young cat. Caged; put on pure milk culture, two days old, of V, August 29.

August 30.—Nothing abnormal noticed; no diarrhœa.

August 31.—Slight diarrhœa,—that is, stools soft, brownish, with mucus.

September 1.—Cat is sick and trembling; no sign of a stool to be found in the cage.

September 2.—Cat died with still no stools in the box.

Owing to my absence for a day and a half no autopsy was made.

CAT IX.—Healthy young cat. Caged; put on pure milk culture, two days old, of M, September 10.

September 11.—Diarrhœa has begun.

September 12.—Cat is now quite shaky; cry is husky, and diarrhœa profuse, the stools being soft and light-colored.

September 16.—The diet on cultures two to three days old, of M, having been kept up, the cat died during the night. The diarrhœa continued to death.

Autopsy.—Lungs normal; heart in diastole; liver, spleen, pancreas, and kidneys normal; stomach contracted, containing a little brown, viscid fluid; intestines contracted, pale; for the most part empty; contents of upper part chyme-like, of lower part brownish-pink, viscid; rectum with soft, light-brown stools. No decided changes to be noted in the walls by the eye; mesenteric glands white, normal in size; mesenteric veins gorged with blood.

But slight general pallor and decidedly more fat than might have been expected.

MICROSCOPIC EXAMINATION.

Stomach.—The cells are all quite clear, even the delamorphic, the nuclei and nucleoli distinct; surface epithelium perfectly clear, and nuclei staining remarkably well. Walls normal; no sign of infiltration. The section shows a small follicle like those in the duodenum, about which there is some adenoid tissue.

Small intestine.—But few scattered round cells below or in villi. In upper part of intestine very few mucous cells, but in the lower part, towards the valve, twenty-five per cent. of the cells are in this state, and the cells are more cloudy.

Solitary and Peyer's patches crowded with large lymph cells.

Large intestine.—Slight increase of adenoid tissue; epithelium looks muddy; but few large mucous cells. The Gram method, however, showed a large number of the cells, though small, to be full of mucus; those of the tips of the villi almost all involved. In some of the mucous cells the nuclei are irregular, as if breaking up.

Mesenteric lymph-gland shows a partial crowding of large lymph cells,—that is, the outer portions are packed solid with cells larger than those in the more open parts.

Spleen not crowded; open; Malpighian corpuscles same, with exception of one near the surface, which is packed full of lymph cells.

Kidneys seem to be normal and cells clear, except for a small point under or in the serous coat, which is crowded with leucocytes.

Bacteria.—A few in mouths of follicles of stomach, increasing in number to the large intestine; but nowhere invading the tissues.

Cultures from the intestine showed a small percentage of L, and about equal numbers of M and *a*. M was the form fed.

Results.—Little besides catarrh of the mucosa was found, and the plant fed.

CAT X.—Cat of fair size, healthy, out in large room; put on milk with pure cultures of E, September 9.

September 12.—The cat is lively and frisky, and plays about just as before being put on diet. The stools, however, are, for the most part, quite fluid, soft, and are in spots distinctly greenish.

September 13.—Diarrhœa has increased; cat quiet; put in a cage.

September 15.—The diarrhœa has increased, and the cat is now feeble. Put on house milk from two to twelve hours old.

September 18.—The diarrhœa continued; the cat remained weak, and died last night rather suddenly.

Autopsy.—Lungs normal; heart in diastole, full of fluid blood; liver softer than usual, dark red, full of fluid blood; spleen the same; kidneys softish, cortex markedly light, size increased (?); bladder full of clear urine.

Peritoneum smooth, shining, containing about two and a half drachms of clear fluid.

Stomach white, almost empty, containing a thin coat of dark-brown, slimy fluid; no change in coats could be affirmed.

Intestines contracted, light on the outside, inside with patches of light pink, but mostly almost white, inner coats swollen; contents, a little of the same material found in the stomach. Rectum dark, with semi-solid fæces. Mesentery glands enlarged.

MICROSCOPIC EXAMINATION.

Stomach and intestines.—Epithelial cells rather cloudy, not so much so as Kitten VIII.; very few mucous cells. There is a certain amount of round-cell infiltration, especially in the folds.

Kidneys.—Glomeruli; a trifle swollen.

Spleen rather full of leucocytes, but still open around the larger trabeculæ.

Mesenteric lymph-gland decidedly crowded with leucocytes.

Liver.—The nuclei stain very little, and in a good many the nucleoli are scattered; spreading from the intra-acinal vessels the parenchyma is infiltrated with deep staining cells of the connective-tissue class, round or triangular. The Gram method brings to light the fact that not a few of these contain stained granular matter, like mast cells.

Bacteria found only in glands and between villi of gut, most in lower part; form the small diplo-bacilli of the non-dissolving group. The liver is distinctly the most affected organ.

Swelling of mesenteric lymph-glands. Cultures made from contents of stomach and intestine failed to show E, the form fed, but did show M, the form fed to Cat IX.

Kitten XI.—Healthy; at large in room; was fed with the whole of an abundant potato culture of E, September 23. This was done by mixing the culture with some finely-minced raw beef.

September 24.—Kitten is perfectly well and stools normal.

September 26.—The kitten is still well and stools normal.

October 1.—Kitten still at large; put on milk inoculated six days before with E. Before being fed to the kitten the milk was steamed for an hour. The milk curdled on being steamed.

October 2.—Stools light-colored, soft, frequent.

October 3.—Stools soft, clay-colored like dysenteric stools.

October 4.—Constipation; kitten is weak and restless; appears to be in pain.

October 5.—Died early in the morning, with continued constipation.

Autopsy.—Right side of heart dilated; left side in systole; blood fluid; lungs normal; liver soft, rich in blood; spleen normal in appearance; kidneys soft, swollen, cloudy.

Stomach pale, distended with two drachms of green water.

Small intestines white, contracted, empty.

Large intestines greatly distended with refuse of food; this in places forming dry, solid fæces, in places soft and viscid.

Peritoneum shining, transparent.

No note of glands in mesentery.

Body rather fat.

Cat XII.—Healthy kitten, at large in a room; fed with C in the same way as last kitten, September 23.

September 24.—No sign of disease; stools normal.

September 25.—No sign of disease; stools normal.

October 1.—Kitten put on sterilized cultures of C, same way as last kitten.

October 3.—Marked diarrhœa has begun; the stools soft, semifluid, brown.

October 4.—Kitten died in the afternoon, the diarrhœa having continued.

Autopsy.—No general pallor, and considerable amount of fat. Heart in systole; blood all over body fluid; no sign of a clot; corpuscles settled to the bottom of the vessels.

Lungs pink, apparently perfectly normal. Liver soft, with much blood. Spleen distinctly enlarged, soft, pulpy. Kidneys, subcortical area, distinctly reddened; corpuscles more distinct than usual in cats.

Peritoneum shining, transparent.

Stomach pale, inner coats swollen, mucosa covered with a thick pus-like-looking coat.

Duodenum same as stomach; rest of intestine pale; most parts contracted, but not offering any distinct changes in walls. Lower part of colon and rectum much distended with fæces. Those close to the anus solid, surrounded by a thick coat of mucus; those above soft and slimy.

MICROSCOPIC EXAMINATION.

Stomach.—Cells of mucosa clear; gland cells of both kinds easily found; submucosa normal.

Small intestine.—Cells of mucosa clear, square; nuclei distinct, but few mucous cells. Submucosa with many leucocytes; muscular coat normal.

Large intestine the same.

Kidneys seem normal; no cloudiness.

Liver.—Slight increase of young round cells about smaller portal veins and some mast cells, but liver cells normal.

Bacteria in and on surface of intestines, but not one found in stomach.

Result.—Catarrh and round-cell infiltration of stomach and intestines, beginning round-cell infiltration of liver, and congestion of large glands of abdomen.

The two cholera infantum kittens were also carefully examined. The intestines and stomach were pale, but the microscope showed no change. The mesenteric glands were much enlarged; spleen also enlarged.

The trouble from which the kittens suffered may fairly be compared with summer diarrhœa of infants. In both, diarrhœa, catarrh of the mucosa, round-cell infiltration of submucosa, erosions, enlargement of the lymph-glands.

The cases of constipation in the kittens have their equivalent among children, and are explainable in two different modes. In one class of cases the intestine is small and the contents very dry, even the mucus; in the other, the lower parts of the intestine are enormously dilated and the contents often quite soft, mushy. In the first class it is clear that the dry contents are going to offer great resistance to peristalsis,—would seem able to overcome it. In the second class we have the picture of paralysis of the intestines.

Some may hold the liver too much affected; but it was not more affected than in reported cases of summer diarrhœa in children. The liver is a stumbling-block in pathology to any but experts, especially in children, and the changes reported are of a nature not to be recognized by the methods used by those who deny that it is affected.

The cause of the trouble in the kittens must be attributed to the food. The food was the only change made, and it is utterly improbable that the kittens put on the affected milk all became affected by some accident, while other kittens beside them remained healthy.

The question therefore is, how the food caused the diarrhœa. Since the bacteria were the only change in the food they must be held responsible. The bacteria might act as specific plants working their way into the system, as anthrax, tuberculosis, chicken cholera; or by flourishing in the intestines and there producing poisons, or by producing poisons in the milk. That general infection occurred is improbable; no evidence of it was found, and the autopsies do not indicate it. That the chief mode of action was by dead matter in the milk is indicated by the failure to find the plants growing in the milk in the alimentary canal, by the fresh cultures in meat not acting, and by old sterilized milk cultures acting.

It is apparent, therefore, that, with the exception of Experiment IX., the disease was induced by changes wrought in the milk before being fed.

In Experiment IX. the form fed was found in numbers in the intestine, and as it is known to produce decided changes in cultures, it may be assumed to have acted both in the intestines and in the milk. The occurrence of M in a later experiment tends to strengthen the evidence in favor of its acting in the intestines.

This brings us to the kinds found in the intestines of the kittens. Did they help to produce the disease? This the experiments do not directly answer; but knowing that the forms found are active species, not normal in the intestine, similar or identical with the abnormal species found in the stools of children, it is fair to believe that they did; a conclusion also indicated by the disease progressing after the kittens were put on unaltered milk. Were the active principles limited to the milk, the kittens should not have slowly progressed to death.

To sum up, the kittens became affected with summer diarrhœa, owing to the products of the growth of bacteria in the milk feed and in the intestines.

The variations in the histories of the disease and the autopsies are to be attributed to the variations in the cause. One plant is not the same as another, and several plants were acting in each case. As is natural, the variable, multiple causes gave variable results, closely related in nature as the causes are closely related. No specific plant is indicated, indeed is distinctly contraindicated.

In view of the similarity, often identity, of the bacteria acting on the cats and children, the close resemblance of the symptoms in the two, and the similar results at autopsy, it is justifiable to conclude that the results gained from the kittens may be transferred to the children,—that is, that summer diarrhœa in children is the result of the products of growth of bacteria in the food and in the alimentary canal; a result in unison with the generally expressed belief that fermentation is the cause.

Passing a step further, the symptoms, pathology, and etiology of summer diarrhœa stand in close relationship with the group of symptoms first clearly brought to light by Panum as putrid infection. The animals poisoned by the injection of putrid fluids, sterile or not, sicken and die with two variable groups of symptoms, one referable to the nervous system, the other to the intestines, diarrhœa being a prominent symptom, and the autopsy revealing inflammatory changes in the intestine. Besides the more general effects, many of the poisons formed by bacteria tend, if introduced into the system, to localize their effects upon the intestines. This is also true of Brieger's bacillus and the lactic acid bacillus of Escherich.

Passing to the mode of introduction of the bacteria, it is probable,—almost certain,—judging from cases, that certain forms are able to slip in, multiply, and produce disease in the healthy infant. Very like the two active fermenters O and V are such forms in infants. Other forms need assistance; they are not able to thrive in the normal healthy infant intestine; it is here that the predisposing causes of heat, food, catching cold, and the like, come in. They throw the digestion sufficiently out of order to give the plants a start.

Improper feeding offers fine opportunities, good food for bacteria scarcely acted upon by the infant and perturbed digestion. That the food is not used up by the infant is of great importance, since it leaves the plants free of competitors.

Catching cold may also be a factor, the circulation and functions of the digestive tract being thrown out of gear in a parallel way to that shown by experiment to occur in the lungs.

Heat probably acts directly in common with crowding by debilitating the system; but it is through the food that heat seems to exert its chief influence. During warm weather the milk fed to infants is at a sufficient temperature to allow the bacteria to flourish and produce the same changes that occurred in the milk fed to the kittens. Besides this, bacteria are much more abundant everywhere. Simple heat in the house is not at all the same thing: first, the food is kept cool, though the house be hot; second, the walls and floors are cold and dry, which cuts down the numbers of the bacteria.

A sort of vicious circle thus tends to be established in the summer. Bacteria are flourishing everywhere, and must be constantly gaining access to the stomach. The digestion is disturbed, harmful bacteria slip in and disturb it still more. The intestines react, produce much mucus, altered digestive fluids, and tend to inflame. This favors the bacteria; they flourish still more, the bowels get worse, and so it goes on.

It may fairly be asked why, if bacteria are floating about and cause so much trouble in infants, more is not heard from them in adults. But diarrhœa is a feature among adults during the same periods, and in all probability due to much the same class of causes. That the diarrhœa does not usually attain such importance is probably due to the greater power of resistance of adults, the more stable nervous system, the more active chemistry of digestion, and the fact that adults are able to take care of themselves when sick. It is also possible that the variable diet of adults gives more forms in the intestines which injure each other and prevent enough of any one poison being formed, and at the same time tends to starve out one form and then another.

In regard to prophylaxis, it is clear that bottle-fed infants should have sterile food, just as adults, especially during the hot months. By this means a swarm of plants are kept out of the digestive tract, and the products of putrefaction and fermentation are avoided. The stomach can then start fair and work unhampered on the, at best, unsatisfactory substitutes for breast-milk.

To avoid the more active forms, which are capable of forcing their own way, is probably impossible, but the stools should certainly be disinfected.

Once given an attack of summer diarrhœa, the desire to kill the bacteria in the digestive tract at once suggests itself. Unfortunately we have yet to find a germicide which is not an infanticide also. No experiments exist for children, but those of Luchsdorff on an adult show that sterile food is quite effective in reducing the numbers of bacteria in the intestines. This probably explains the benefit of sterilized milk in diarrhœa, be it in old or young.

Escherich, who has gone deeply into the subject, and whose articles I would advise those interested to consult, suggests starving the bacteria by giving albuminous foods in cases of fermentation, and vegetable in putrefaction. The difficulty is to tell which is going on in the child, or perhaps both may be acting at the same time. Where sterile food is not well borne, therefore, it seems desirable to cut off food for a time as much as possible. Personally, therefore, the writer has a sort of series from breast-milk to sterilized milk, wine-whey, and, lastly, spirits and water. Like adults, infants in need will take a great deal of spirits.

As the products of the bacteria produce the damage, it is justifiable to endeavor to render these inert. But here, again, knowledge is very scarce. Iodoform is known to do this with cadaverin; calomel apparently does the same; at least the products of putrefaction diminish in the urine while good evidence of a germicidal action is not forthcoming. Tannin also offers some chance of rendering the products insoluble. But as everything has been tried, and calomel alone holds its own, there is little hope of attaining satisfactory results in this line unless some new drug is found.

The writer is among those having more or less faith in the so-called alkaline treatment, especially as represented by the acid salt bicarbonate of soda. Perhaps it acts in a peculiar manner in virtue of being an acid salt with an alkaline reaction.

Over and above the bacteria it must not be forgotten that we have a child with lesions of the digestive tract to consider. This, though very important, is beyond the scope of this paper.

DISCUSSION.

Dr. Northrup.—The paper of Dr. Jeffries points positively to the importance of sterilizing milk before it goes into the baby's stomach. Dr. Fruitnight has mentioned that St. John's Guild has taken a step in advance by doing away with long bottle-tubes. The Guild could easily take one more and an important step by sterilizing, on a large scale, bottles and tubes and milk.

At the New York Foundling Asylum the milk destined to go to the feeding of children is sterilized in a chamber of live steam, and, of course, the amount of milk required is enormous. The bottles of milk with cotton stoppers are placed in a metal chamber, in which is a coil of steam-pipe perforated with fine holes along the concave surfaces. The walls of the chamber are cast iron, and the temperature everywhere within is thought to be raised to 212° F., and to be held at that point indefinitely. It has been demonstrated that dry air at 284° F. will kill the spores of anthrax in four hours, and these spores are very tenacious of life. Steam at 212° F. will kill the same spores in five minutes.

If the milk be stored in bottles larger than ordinary nursing-bottles, it is important to allow it to remain longer, and this point must not be overlooked. The rule may well be laid down that every particle and every globule within the sterilizing chamber should be maintained at a temperature of 212° F. for forty-five minutes.

This method of preparing milk at the Asylum has met with the approbation of all concerned,—physicians, Sisters of Charity, nurses, and assistants. Among other reasons is the fact that there is no need to keep the milk in the ice-house, and no need for elaborate preparations.

I feel a deep interest in the valuable work done by Dr. Jeffries, and am glad to hear his results at this time.

Dr. Booker.—It is gratifying to know that some one else has taken up this difficult question, one of great interest and importance, which, carefully worked out, will no doubt add much to our understanding of the conditions pertaining to the summer diarrhœas of children.

The subject is complex and apparently endless, and will probably require years of patient, tedious labor before any definite conclusions can be reached.

As the author has only been able, in the time allowed, to give a short abstract of his paper, it hardly admits of discussion.

Dr. Thomas presented, for Dr. Osler, a brain showing dilatation of the ventricle; a brain showing local sclerosis; a case of palsy of the left arm with atrophy.

Dr. Caillé moved that the thanks of the Society be extended the President for his untiring efforts in behalf of the successful meeting which had been held.

Carried.

Dr. Earle moved the thanks of the Society be tendered to the Committee of Arrangements and to the management of Johns Hopkins Hospital for courtesies extended.

Carried.

The President.—I have been exceedingly well pleased with the results of this meeting. I had made very little preparation for it, as I was anxious to see how much spontaneity there would be in the preparations on your part. I have been waiting for offers of papers, and I have not been disappointed.

As I said in my inaugural address, I have never been more satisfied than I am at this present time of the necessity for such a society, after I have seen how general the interest in it has proved to be.

You have had a number of papers before you, and they have been well discussed. We have had a number of discussions which I think the profession at large will appreciate when they see them in print.

It is I who have to thank you for the honor conferred upon me. Certainly it is an honor to be the first President of a Society which has been able to do so much. I expect that in the future this Society will do much both for the medical profession at large and for the public, which has to depend so much upon the accomplishments and services of the profession.

What we have to be thankful for is the kindness with which we have been received and the opportunity which has been given us by the authorities of Johns Hopkins Hospital to hold our meeting here and to see the institution.

Adjourned, subject to the call of the Council.

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