TRANSACTIONS OF AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION 1897

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TRANSACTIONS

OF THE

SEVENTH ANNUAL MEETING

OF THE

American Electro-Therapeutic Association,

HELD

September 21st, 22nd and 23rd, 1897,

AT HARRISBURG, PA.

Published by the Association.

TORONTO:
PRINTED BY WILLIAM BRIGGS, WESLEY BUILDINGS.

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Time and place of next meeting: Tuesday, Wednesday and Thursday, September 13th, 14th and 15th, 1898, at Buffalo, N.Y.

COMMITTEES.

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GEORGE J. ENGELMANN, M.D., *Chairman.*

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COMMITTEE ON CATAPHORESIS:

AMOS E. DOLBEAR, M.A., PH.D., *Chairman.*

FREDERICK PETERSON, M.D. G. BETTON MASSEY, M.D.

HONORARY FELLOWS.

Apostoli, Dr. Georges, 5 Rue Moliere, Paris, France.
D'Arsonval, Prof. Dr. A., 28 Avenue de l' Observation, Paris, France.
Benedict, Prof. Dr. I. Franziskanerplatz 5, Vienna, Austria.
Bergonié, Prof. Dr. J., 9 bis Rue du Temple, Bordeaux, France.
Carhart, Prof. H. S., University of Michigan, Ann Arbor, Mich.
Clark, Dr. W. Bruce, M.A., M.B., F.R.C.S., 51 Harley Street, W., London, England.
Dolbear, Prof. Amos E., A.B., A.M., M.E., Ph.D., Tufts College, Mass.
Gautier, Dr. Georges, 7 bis Rue du Louvre, Paris, France.
Houston, Prof. Edwin J., Ph.D., 1809 Spring Garden Street, Philadelphia, Pa.
Jenks, Wm. J., E.E., 120 Broadway, New York, N.Y.
Keith, Dr. Skene, 42 Charles Street, Berkeley Sq., W., London, England.
Kennelly, A. E., Sc.D., F.R.A.S., Crozer Building, Philadelphia, Pa.
Langley, Prof. W., Case School of Applied Science, Cleveland, Ohio.
Larat, Dr. J., Laboratoire d'Electrotherapie, 3 Place du Theatre Francais, Paris, France.
La Torre, Dr. Felice, 3 Via XX Settembre, Rome, Italy.
Massin, Dr. Wassli, Wassli Astrow, St. Petersburg, Russia.
McClure, Dr. Henry, Cromer, England.
Mitchell, Dr. S. Weir, LL.D., 1524 Walnut Street, Philadelphia, Pa.
Parsons, Dr. J. Inglis, 3 Queen Street, Mayfair, W., London, England.
Soutakis, Dr., Constantinople, Turkey.
Temesvary, Dr. Rudolff, Erzebetkorut 32, Budapest vii, Hungary.
Tesla, Nikola, E.E., 55 West 27th Street, New York, N.Y.
Thomson, Prof. Elihu, Lynn, Mass.

FELLOWS.

Beaver, Dr. D. B. D., 150 North 6th Street, Reading, Pa.
Bigelow, Dr. Horatio R., 36 Rue Jeanne d'Arc, Rouen, France.
Bill, Dr. George E., Harrisburg, Pa.
Bishop, Dr. Francis B., 1913 I Street, Washington, D.C.
Bishop, Dr. William T., Harrisburg, Pa. President in 1897.
Brown, Dr. Caleb, Sac City, Iowa.
Brown, Dr. Lucy Hall-, 158 Montague Street, Brooklyn, N.Y.
Brower, Dr. D. R., 597 Jackson Boulevard, Chicago, Ill.
Burton, Dr. Oliver H., 632 Central Avenue, Hot Springs, Arkansas.
Cabot, Dr. Caroline A., 168 West 48th Street, New York City.
Call, Dr. Emma L., 42 Newbury Street, Boston, Mass.
Cannady, Dr. C. G., 112½ Jefferson Street, Roanoke, Va.
Charlton, Dr. Thomas J., 220 Oglethorpe Avenue E., Savannah, Ga.
*Cleaves, Dr. Margaret A., 79 Madison Avenue, New York City.
Coe, Dr. Henry Waldo, 714 Marquam Building, Portland, Ore.
Corson, Dr. Eugene R., 115 Jones Street, Savannah, Ga.
Crossfield, Dr. Frederick S., 26 Pratt Street, Hartford, Conn.
Davis, Dr. J. Griffith, 200 West 14th Street, New York City.
Dickson, Dr. Charles R., 343 Sherbourne Street, Toronto, Canada.
Douglas, Dr. O. B., 123 East 36th Street, New York City.
Einhorn, Dr. Max, 20 East 63rd Street, New York City.
Engelmann, Dr. G. J., 336 Beacon Street, Boston, Mass.
Fairbanks, Dr. C. O., 25 West 45th Street, New York City.
Ford, Dr. Willis E., 266 Genesee Street, Utica, N.Y.
Free, Dr. Spencer M., Duboid, Pa.
Gehring, Dr. E. C., N. E. corner Westminster Place and Vandeventer Avenue, St. Louis, Mo.
Gerin, Dr. John, 68 North Street, Auburn, N.Y.

* Present at the first meeting, and founders of the Association.

Gillette, Dr. Henry W., D.M.D., 130 Touro Street, Newport, R.I.
Gray, Dr. George H., 4 Washington Street, Lynn, Mass.
Gray, Dr. Landon Carter, 6 East 49th Street, New York City.
Grier, Dr. M. J., 1531 Spruce Street, Philadelphia, Pa.
Hahn, Dr. H. H., 304 East Federal Street, Youngstown, O.
Hammond, Dr. G. M., 58 West 45th Street, New York City.
Herdman, Dr. Wm. J., 48 East Huron Street, Ann Arbor, Mich. President in 1894.
Heuel, Dr. Emil, 352 Willis Avenue, New York City.
Hickling, Dr. D. Percy, 231 Third Street, N. W., Washington, D.C.
Holladay, Dr. Robert, 632 Central Avenue, Hot Springs, Arkansas.
Jewett, Dr. Henry S., 21 South Ludlow Street, Dayton, O.
Kellogg, Dr. J. H., Battle Creek, Mich.
La Forest, Dr. George, 274 St. Denis Street, Montreal, Canada.
Lawhead, Dr. H. D., Woodland, Yolo County, Cal.
Lodor, Dr. Charles H., 3136 Indiana Avenue, Chicago, Ill.
Martin, Dr. C. W., Topeka, Kan.
Martin, Dr. Franklin, 34 Washington Street, Chicago, Ill.
*Massey, Dr. G. Betton, 1636 Walnut Street, Philadelphia, Pa. President in 1891.
McBrayer, Dr. Louis B., 32 Patton Avenue, Asheville, N.C.
McGinnis, Dr. E. H. L., 329 Amsterdam Avenue, New York City.
*Morton, Dr. William J., 17 East 28th Street, New York City. President in 1892.
Morse, Dr. Frederick D., Melrose, Mass.
*Mosher, Dr. Eliza M., Ann Arbor, Mich.
*Newman, Dr. Robert, 64 West 36th Street, New York City. President in 1896.
Newton, Dr. Robert Safford, 19 East 44th Street, New York City.
Neylan, Dr. D. J., 172 Hope Street, Bristol, R.I.
Nickerson, Dr. N., 16 West Main Street, Meriden, Conn.
Nunn, Dr. Richard J., 119½ York Street, Savannah, Ga.
Osman, Dr. C. Frank, 21 Mayfield Street, Dorchester, Boston, Mass.
Overall, Dr. George W., 46 North Court Square, Memphis, Tenn.
Perkins, Dr. Edward A., 677 Tremont Street, Boston, Mass.

* Present at the first meeting, and founders of the Association.

Peterson, Dr. Frederick, 60 West 50th Street, New York City.
Phelps, Dr. O. S., 332 West 56th Street, New York City.
Phillips, Dr. Wendell C., 360 Madison Avenue, New York City.
Pitcher, Dr. Herbert F., Haverhill, Mass.
Pope, Dr. Curran, 115 West Chestnut Street, Louisville, Ky.
Riggs, Dr. C. Eugene, The Endicott Arcade Building, St. Paul, Minn.
Robinson, Dr. W. F., 59 Washington Avenue, Albany, N.Y.
Rockwell, Dr. A. D., 113 West 34th Street, New York City.
Ross, Dr. Frank W., 164 Lake Street, Elmira, N.Y.
Schavoir, Dr. F., 8 Atlantic Street, Stamford, Conn.
Scheppegrell, Dr. W., A.M., 3723 Prytania Street, New Orleans, La.
Sherman, Dr. A. L., 325 Ninth Street, Brooklyn, N.Y.
Shannon, Dr. J. E., 4 West Main Street, Sharon, Tenn.
Silvers, Dr. Elihu B., cor. Irving and Grand Streets, Rahway, N.J.
Simmons, Dr. Alpheus Butts, Savannah, Ga.
Slaughter, Dr. Robert M., Theological Seminary, Va.
Sprague, Dr. W. B. 324 Warren Avenue, Detroit, Mich.
Stratton, Dr. John A., Newman, Stanislaus County, Cal.
Thomas, Dr. J. G., Mobile, Ala.
Walker, Dr. Holford, 56 Isabella Street, Toronto, Canada.
Wallace, Dr. Frank H., 711 Boylston Street, Boston, Mass.
Walsh, Dr. Thomas C., 331 Montgomery Street, Syracuse, N.Y.
Watkins, Dr. R. L., 48 West 37th Street, New York City.
Watson, Dr. William S., Fishkill-on-Hudson, N.Y.
Wedgewood, Dr. Milton C., Lewiston, Me.
Weeks, Dr. Stephen, 620 Congress Street, Portland, Me.
Weigel, Dr. Louis A., 209 East Avenue, Rochester, N.Y.
Wende, Dr. Ernest, 471 Delaware Avenue, Buffalo, N.Y.
White, Dr. W. H., 222 Marlborough Street, Boston, Mass.
Wolff, Dr. Lawrence, 333 South 12th Street, Philadelphia, Pa.
Wood, Dr. Horatio R., 1005 Masonic Temple, Chicago, Ill.
Woolsey, Dr. Elliot H., 1103½, Oakland, Cal.
Weichselbaum, Dr. Jacob, 111 Whitaker Street, Savannah, Ga.

ASSOCIATE FELLOWS.

Brown, R. G., E.E., 158 Montague Street, Brooklyn, N.Y.
Cabot, John A., E.E., Chief Electrician, Board of Administration, Cincinnati, O.
Carty, John J., E.E., Vice-President, New York Electrical Society, 18 Cortland Street, New York City.
Hammer, Edwin W., E.E., 20 Broadway, New York City.
Lawrence, Newman, M.I., E E., Ozone Park, Long Island, N.Y.
Scott, Charles T., M.A.I., E.E., Pittsburg, Pa.

In Memoriam.

Honorary Fellows.

Dr. Onimus, Paris, France, 1896.
Dr. E. DuBois Reymond, Berlin, Germany, 1896.
Dr. Thomas Keith, London, England, 1897.

Fellows.

Dr. John Chambers, Indianapolis, Indiana, 1892.
Dr. Plym S. Hayes, Chicago, Ill., 1893.
Dr. William F. Hutchinson, Providence, R.I., 1893.
Dr. S. T. Anderson, Bloomington, Ill., 1896.
Dr. Charles W. Wiley, Vineland, N.J., 1897.

CONSTITUTION AND BY-LAWS

OF

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

CONSTITUTION.

I. The name of this Association shall be the American Electro-Therapeutic Association.

II. Its object shall be the cultivation and promotion of knowledge in whatever relates to the applications of electricity in medicine and surgery.

MEMBERS.

III. The members of this Association shall consist of Ordinary Fellows, Honorary Fellows, Associate Fellows, and Corresponding Fellows, who shall be practitioners of medicine in good standing, or electrical experts.

The Ordinary Fellows shall not exceed one hundred and fifty in number.

The Honorary Fellows shall not exceed ten American and twenty-five foreign.

Candidates shall be proposed to the Executive Council one month before the first day of meeting by two Fellows, and when recommended by the Council shall be balloted for at the annual meeting, a list of the proposed names having been sent to every Fellow with the notification of the meeting.

Every candidate for admission to the Association shall be required to present a paper to the Executive Council, at least one month before the annual meeting.

A two-thirds vote in the affirmative of all the members present shall be necessary to elect; fifteen Fellows at least being in attendance.

Honorary Fellows.

IV. The power of nominating Honorary Fellows shall be vested in the Executive Council.

Their election shall take place in the same manner as that of Ordinary Fellows.

They shall enjoy all the privileges of Ordinary Fellows, excepting to vote or hold office, but shall not be required to pay fees or dues.

V. The Associate Fellows shall be recommended by the Executive Council, and elected by the Association.

They shall enjoy all the privileges of Ordinary Fellows, excepting to vote or hold office, but shall not be required to pay fees or dues.

Corresponding Fellows.

VI. The Corresponding Fellows shall be recommended by the Executive Council, and elected by the Association.

They shall enjoy all the privileges of Ordinary Fellows, excepting to vote or hold office, and shall be entitled to a copy of the Annual Transactions.

They shall pay an entrance fee of twenty dollars.

Officers.

VII. The officers of this Association shall be a President, two Vice-Presidents, a Secretary, a Treasurer and five Executive Councillors.

The nomination of all officers shall be made in open session at the business meeting, and the election shall be by ballot, the result being determined by a majority of those present and voting.

The officers shall enter upon their duties immediately before the adjournment of the meeting at which they were elected, and shall hold office for one year.

Any vacancy occurring during the recess may be filled temporarily by the Executive Council.

Annual Meetings.

VIII. The time and place of holding the annual meeting shall be determined by the Association each time before adjournment.

It shall continue for three days, unless otherwise ordered by vote of the Association.

Amendments.

IX. This constitution may be amended by a two-thirds vote of all the Fellows present and voting at an annual meeting. Provided that notice of the proposed amendment has been given in writing at the annual meeting next preceding. And provided further, That it shall have been printed in the notification of the meeting at which the vote is to be taken.

BY-LAWS.

The Presiding Officer.

I. The President, or, in his absence, one of the Vice-Presidents, shall preside at all meetings and perform such other duties as ordinarily pertain to the Chair.

The presiding officer shall be ex-officio Chairman of the Executive Council, but shall vote therein only in case of a tie.

Secretary.

II. The Secretary shall attend and keep a record of all meetings of the Association and of the Council, of which latter he shall be ex-officio Clerk, but shall not be entitled to vote therein.

He shall collect all moneys due from the members and shall pay the same over to the Treasurer, taking his receipt therefor.

He shall supervise and conduct all correspondence of the Association; he shall superintend the publication of the Transactions, under the direction of the Executive Council, and shall perform all the ordinary duties of his office.

He shall be the custodian of the seal, books, and records of the Association.

Treasurer.

III. The Treasurer shall receive all moneys from the Secretary, pay all bills, and render an account thereof at the annual meetings, when an auditing committee shall be appointed to examine his accounts and records.

Executive Council.

IV. The Executive Council shall meet as often as the interests of the Association may require. The President or any three members may call a meeting and a majority shall constitute a quorum.

It shall have the management of the affairs of the Association, subject to the action of the Association at its annual meetings.

It shall have control of the arrangements for the annual meetings, and shall determine the order of reading of papers.

It shall constitute a court of inquiry for the investigation of all charges against members, for offences involving law or honor, and shall have the sole power of moving the expulsion of any Fellow.

Order of Business.

V. The Order of Business at the annual meetings of the Association shall be as follows:

1. General meeting at ten o'clock a.m. each day.
   (1) Reports of Committees on Scientific Questions.
   (2) Reading of papers and discussions of the same.
2. The business meeting shall be held at half-past eight o'clock p.m., on the second day of the session (unless otherwise ordered by vote), at which only the Fellows of the Association shall be present. The Secretary's report shall then be read; the Treasurer's

accounts be submitted; the reports of committees on other than scientific subjects be offered, and all miscellaneous business be transacted.

Papers.

VI. The titles of all papers to be read at any annual meeting shall be furnished to the Secretary not later than one month before the first day of the meeting.

No paper shall be read before this Association that has already been published, or that has been read before any other body.

Not more than thirty minutes shall be occupied in reading any paper before the Association.

All papers read before the Association shall become its sole property if accepted for publication; and the Executive Council may decline to publish any paper not handed to the Secretary complete before the final adjournment of the annual meeting.

Quorum.

VII. The Fellows present shall constitute a quorum for all business, excepting the admission of new Fellows, or acting upon amendments to the Constitution, when not less than fifteen Fellows must be present.

Decorum.

VIII. No remarks reflecting upon the personal or professional character of any Fellow shall be in order at any meeting, except when introduced by the Executive Council.

Finance.

IX. Each Fellow, on admission, shall pay an initiation fee of fifteen dollars which shall include his dues for the first year.

Every Fellow shall pay in advance the sum of five dollars annually thereafter.

Any Fellow neglecting to pay his annual dues for two years shall forfeit his membership.

A contingent fund of one hundred dollars shall annually be

placed at the disposal of the Secretary for current expenses, to be disbursed by him, and for which he shall present proper vouchers.

Attendance.

X. Any Fellow who shall neither attend nor present a paper for three consecutive years shall, unless he offer a satisfactory excuse, be dropped from fellowship upon a vote of the Executive Council.

Rules.

XI. "Robert's Rules of Order" shall be accepted as a parliamentary guide in the deliberations of this Association.

Amendments.

XII. These by-laws may be amended or suspended by a two-thirds vote of the Fellows present and voting at any meeting.

PROCEEDINGS

OF THE

SEVENTH ANNUAL MEETING

OF THE

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION,

HELD AT THE ACADEMY OF MEDICINE, HARRISBURG, PA.,
SEPTEMBER 21ST, 22ND AND 23RD, 1897.

First Day—Tuesday, September 21st.

MORNING SESSION.

The meeting was called to order by the President, Dr. William T. Bishop, of Harrisburg, Pa., at 10.10 a.m. Divine blessing was invoked by the Rev. LeRoy F. Baker.

The following address of welcome was delivered by his Honor John D. Patterson, Mayor of Harrisburg.

ADDRESS OF WELCOME.

Mr. President, Ladies and Gentlemen,—At the request of my esteemed friend, the President, Dr. Bishop, I have come here to extend a very brief and formal welcome to the representatives of the American Electro-Therapeutic Association. It is a very pleasant duty to extend the welcome to representative men, especially those representing so eminent a profession as yours. We shall try to make you at home within our city. Our city is beautifully situated, and it is easy of access on account of its unsurpassed railroad facilities. Our hotels have all the modern improvements for your comfort, and our city is supplied with an unlimited quantity of surprisingly good water, and is surrounded by pure air. Our

medical gentlemen, whom we esteem and honor for the profession which they represent so well, will make you welcome. They are interested in your work, and our community feels that whatever interests them interests the community, viz., the surprising and wonderful discoveries that have been made in the use of electricity in discovering and locating diseases and injuries, and the application thereof to restore the sick and the weak to health.

Now, on behalf of our medical friends, and on behalf of the people at large, we extend you a most cordial and generous welcome to our city. May your conferences be fraught with much benefit to your profession, may they be pleasant, may you find your stay in our midst of a pleasant character, may you return to your homes in safety with kindest remembrances of our community.

On behalf of our medical friends and the people of Harrisburg, I tender you a most earnest and hearty welcome to our midst.

Response to the Address of Welcome by Dr. Robert Newman, New York.

Mr. President, Ladies and Gentlemen,—It is my agreeable privilege to return sincere thanks on behalf of the American Electro-Therapeutic Association for the warm welcome and eloquent address to which we have just listened. These kind words will be a lasting souvenir in the gardens of our recollections. I wish I were able to express the sentiments of thanks of our members, but I know full well my inability to do justice to the occasion —in fact, I think our worthy President retaliates because of a speech that I asked him to make at our last meeting. I received no notice that I was to answer the Address of Welcome until last evening; I therefore ask your indulgence for my shortcomings, which are, perhaps, to some extent at least, hereditary.

This Association has been spoiled by the splendid receptions given by our hosts on former occasions, so that they expect something grand. On a similar occasion, a mayor welcomed us and extended to us the freedom of the city, and added that he had instructed his police not to interfere with any members of the Association, and, if necessary, to assist such back to their hotels. There is no necessity for such a thing in this case, and hence I am

glad that your mayor has omitted this. We are not intemperate, and there is a good water supply here. We attend strictly to business—indeed, some of our members are prohibitionists. Once, I jokingly said to such a member that water had killed a great many more people than alcohol. The reply was: "Do you mean to say that many people are killed by drinking water?" "Not at all," said I, "but simply that water drowns many people." (Laughter.) There is no necessity for any special safeguards here, because if one should indulge too much, electricity will sober one up quickly.

I have been asked: "Why do you meet in Harrisburg; why not go to a first-class city?" Now, I consider Harrisburg a first-class city; we wish to see this city, and especially to see the State from which Franklin originated—the father of static electricity, or that form often called "Franklinic" electricity. Again, our worthy President hails from this place, and we know that he has facilities for making this meeting a great success. In addition, we prefer the capitol of this State to the city of Wanamaker. (Laughter.) It is not our intention to speak of electrocution, but of the uses of electricity in the amelioration of human ailments. Electricity is used for everything—heating, cooking, railroading, killing and curing. Even to East India electricity has gone, and the houses have been fenced in by two sets of wires connected with an induction apparatus. Now, if snakes or other unwelcome reptiles climb up on these wires, they will be killed, or will at least be compelled to beat a hasty retreat. We will demonstrate this experiment here if you will only furnish us the snakes. (Laughter.) The air may be purified by electricity, but this is not needed in this healthy city. Even hopeless paralytics have been cured by a flash of lightning—even without the assistance of our Association. The wonders of electricity and the Roentgen rays are the culminating luxuries of invention. Progress still continues, but time does not permit me to mention them further. Our medical colleges are behind the time and do not teach medical electro-therapeutics as it should be taught. I believe I do not step on anybody's toes by saying this, as I understand that, strangely enough, there is no medical college in this city.

Let us hope that the work of this meeting will be beneficial to

the members, and will greatly aid the welfare of humanity, so that the public will appreciate the action of electro-therapeutics as a curative agent. Our Association will not neglect the high aim to be fulfilled at this meeting; yet, after our work, we will embrace every moment to enjoy the recreations and pleasures provided for us by our hosts. For these we return our sincere thanks. (Applause.)

On motion of Dr. G. Betton Massey, of Philadelphia, the members of the Harrisburg Academy of Medicine, the Dauphin County Medical Society, and the medical profession generally, were invited to seats, and to take part in the proceedings of the Association.

On motion of Dr. Massey, the executive business on the programme for the morning was postponed, and the Association proceeded to take up the reports of the various committees.

"Report of the Committee on Induction Coils and Alternators." In the absence of Mr. A. E. Kennelly, chairman, Dr. G. Betton Massey reported progress.

"Report of the Committee on Meters," by Dr. Margaret A. Cleaves, of New York, chairman. Discussed by Dr. Massey, who moved, and Dr. Nunn, who seconded the adoption of the report. Discussion was closed by Dr. Cleaves. On motion of Dr. Einhorn, seconded by Dr. Newman, a vote of thanks was tendered Dr. Cleaves for the very painstaking report presented.

Papers were then read as follows:

"Electric Treatment in Gout and the Uric Acid Diathesis," by Dr. Robert Newman, of New York. Discussed by Drs. Cleaves, Massey and Nunn.

"Chorea," by Dr. Francis B. Bishop, of Washington, D.C. Discussed by Drs. Massey, Cleaves, Nunn, and discussion closed by Dr. Bishop.

The Association adjourned at 12.30 p.m.

AFTERNOON SESSION.

The Association was called to order by the President at 2.35 p.m.

"Sources of Atmospheric Electricity," by Dr. R. J. Nunn, of Savannah, Ga. Discussed by Prof. Dolbear, Drs. Blair and Massey.

"Some Thoughts and Suggestions on X-Ray Work," by Dr. Eugene R. Corson, of Savannah, Ga. (read by Dr. Nunn). Discussed by Dr. Massey.

"The Early Electrolysis of Nævus," by Dr. Charles R. Dickson, of Toronto, Canada. Discussed by Drs. Newman, Massey, Nunn, Beaver, and discussion closed by Dr. Dickson.

The Association adjourned at 4.40 p.m.

Second Day—Wednesday, September 22nd.

MORNING—EXECUTIVE SESSION.

The Association was called to order by the President at 9.35 a.m.

The following were recommended for membership by the Executive Council: Dr. George E. Bill, Harrisburg, Pa.; Dr. Alpheus Butts Simmons, Savannah, Ga.; Dr. Milton C. Wedgewood, Lewiston, Me.

On motion of Dr. Massey, the Secretary was instructed to cast the ballot of the Association for the election of these candidates, which being done they were declared Fellows of the Association.

On motion of Dr. Newman, the President appointed the following a Committee on Nominations: Dr. F. Schavoir, Stamford, Conn., and Dr. Caleb Brown, Sac City, Iowa.

The President announced that at 12 noon, the Association would visit the Executive Mansion, and that an exhibition of meters would be given by Dr. Cleaves at 3 p.m.

SCIENTIFIC SESSION.

"Expenditure of Electrical Energy," by Dr. Margaret A. Cleaves, of New York. Discussed by Drs. Dickson and Nunn.

"Molecular Effects of Electricity," by Prof. A. E. Dolbear, of Tufts College, Mass. Discussed by Drs. Massey, Brown and Newman. On motion of Dr. Massey, seconded by Dr. Newman, a vote of thanks was tendered Prof. Dolbear for his highly instructive paper.

"The Influence of Magnetic Stress on Physiological Action," by Dr. W. J. Herdman, of Ann Arbor, Mich. (read by title).

The Association adjourned at 12 noon and visited the Executive Mansion.

AFTERNOON SESSION.

The Association was called to order by the President at 2.25 p.m.

"The New Electro-Mercuric Treatment of Cancer," by Dr. G. Betton Massey, of Philadelphia, Pa. Discussed by Drs. Newman, F. B. Bishop, Prof. Dolbear, Dr. Nunn, and discussion closed by Dr. Massey.

"The Treatment of Urethral Hyperæsthesia in the Male," by Dr. Charles H. Lodor, of Chicago, Ill. (read by title).

The Association adjourned for half an hour at 3 p.m. to witness an exhibition by Dr. Cleaves, of the meters referred to in the Report on Meters.

On reassembling at 3.30 p.m., Dr. Cleaves announced that Dr. Henry McClure, of Cromer, England, an honorary Fellow, had called upon her a short time ago and desired her to convey his greetings to the Association.

"Current-Regulating Apparatus," by Mr. Edward Jewell, E.E., of Chicago, Ill. Discussed by Drs. Nunn, Cleaves, Massey, and discussion closed by Mr. Jewell.

"Report of the Committee on Electrodes," by Dr. Charles R. Dickson, of Toronto, Canada, Chairman.

On motion of Dr. Newman the report was adopted.

On motion of Dr. Gerin, seconded by Dr. Massey, the Association accepted the recommendation of the Committee regarding the adoption of the metric system for all measurements.

"Galvanism as an Aid in the Treatment of Goitre," by Dr, Caleb Brown, of Sac City, Iowa. Discussed by Drs. Dickson, Massey, and discussion closed by Dr. Brown.

"Further Studies on the Manifestation of Uric Acid, and their Treatment, Electrically and Otherwise," by Dr. J. Griffith Davis, of New York. Discussed by Dr. Gerin.

"A New Electrode for Use with the Static Machine," by Dr. Lucy Hall-Brown, of Brooklyn, N.Y. (read by Dr. R. J. Nunn, of Savannah, Ga.). Discussed by Dr. Newman.

The Association adjourned at 5.20 p.m.

EVENING—EXECUTIVE SESSION.

The Association was called to order by the President at 8.35 p.m.

The Committee on Nominations reported as follows:

President, - -	Dr. Charles R. Dickson, of Toronto, Can.
1st Vice-President, -	Dr. Frederick Schavoir, of Stamford, Conn.
2nd Vice-President, -	Dr. Caleb Brown, of Sac City, Iowa.
Secretary, - -	Dr. John Gerin, of Auburn, N.Y.
Treasurer, - -	Dr. Richard J. Nunn, of Savannah, Ga.

Executive Council.

Dr. Robert Newman, of New York, N.Y.
Dr. G. Betton Massey, of Philadelphia, Pa.
Dr. William J. Morton, of New York, N.Y.
Dr. William J. Herdman, of Ann Arbor, Mich.
Dr. William T. Bishop, of Harrisburg, Pa.

On motion the nominations were declared closed.

On motion of Dr. Massey, the Secretary was directed to cast the ballot of the Association for the officers named, and they were declared elected unanimously.

The President, Dr. W. T. Bishop, then delivered his address.

On motion of Dr. Massey, a vote of thanks was extended to the President for his practical and instructive address.

Dr. C. R. Dickson offered the following resolution:

Resolved, That the Executive Council be directed to consider the suggestions contained in the President's Address, and also the matter of the revision of the Constitution and By-laws; that its report be mailed to the members at least one month prior to the next meeting, and that notice of such amendments is now given. Seconded by Dr. R. Newman, and carried.

The President appointed Drs. Caleb Brown and F. B. Bishop a Committee on Audit.

On motion of Dr. Nunn, the Committee on Electrodes was instructed to measure the electrode tip adopted at the Toronto meeting and give the Association the measurements.

Dr. Dickson explained that an effort had been made at the

Toronto meeting to decide this point, but in the hurry of business the matter had been overlooked.

On motion of Dr. Nunn, seconded by Dr. Cleaves, it was resolved that the Association meet at Buffalo next year, if the Executive Council found it practicable to do so.

On motion of Dr. Massey, it was resolved that the Eighth Annual Meeting begin on the second Tuesday in September.

Dr. Nunn moved, That it is the recommendation of the Association that in 1899 the meeting should be held in Washington, D.C. Seconded and carried.

The Association adjourned at 9.45 p.m.

Third Day—Thursday, September 23rd.

MORNING SESSION.

The Association was called to order by the President at 10.30 a.m.

(*a*) "A New Localizing Electrode to Prevent Diffusion of the Current,"

(*b*) "Palliative Treatment of Tic Douloureux of the Face," by Prof. Dr. J. Bergonie, of Bordeaux, France.

(*c*) "The Action of the Roentgen Rays on the Vitality and the Virulence of Cultures of Koch's Tubercle Bacillus," by Profs. Dr. J. Bergonie and Ferre, of Bordeaux, France. Translations of these three papers were read by Dr. F. Schavoir, of Stamford, Conn. Discussed by Dr. Massey.

Dr. Newman moved, seconded by Dr. Cleaves, That Dr. Bergonie receive the thanks of the Association, and that an abstract of the proceedings of the Association be prepared and sent to him for publication in the paper of which he is editor. Carried unanimously.

Dr. F. B. Bishop moved, seconded by Dr. Nunn, That permission be given all members, who so desired, to publish their papers previous to their publication in the Transactions. Carried.

"Report of the Committee on Electric Light Apparatus for Diagnosis and Therapy, and the Roentgen X-Ray," by Dr. Frederick Schavoir, of Stamford, Conn. Discussed by Drs. Massey, F. B. Bishop, Nunn, Newman, Dickson and President Bishop.

EXECUTIVE SESSION.

On the matter being introduced by the President, Dr. R. Newman moved, That this Association expresses its opposition to the enactment of Senate Bill No. 1063 (the anti-vivisection bill), and that a copy of this resolution, properly accredited by the officers, be forwarded to Congress. Seconded and carried.

On motion of Dr. Nunn, seconded by Dr. Cleaves, a vote of thanks was tendered the President for the very able manner in which he had conducted the meeting.

On motion of Dr. Massey, a vote of thanks was tendered the Secretary, Dr. Max Einhorn, for his earnest and satisfactory work; to the Committee on Arrangements, the Harrisburg Academy of Medicine, the Dauphin County Medical Society, and to the medical profession of the adjoining counties, to Messrs. B. F. Fishburn and D. P. Kilgore for their work in carrying on the registration of the meeting, to Dr. George E. Bill and others associated with him in securing the publishing of the local reports of the transactions of the meeting.

Dr. Nunn moved, That the Executive Council be authorized, if they saw fit, to accept advertisements of manufacturers for publication in the volume of the Transactions. Seconded and carried.

On motion of Dr. Nunn, the stenographer, Dr. O. C. Ludlow, was instructed to prepare an abstract of the proceedings of this meeting, to be used by Dr. Dickson for the medical press.

On behalf of the Committee on Audit, Dr. F. B. Bishop reported, That the Committee had examined the report of the Secretary and that the figures were correct. The Treasurer's report had been mislaid and could not be found.

Dr. F. Schavoir, Secretary *pro tem.*, read the report of the Secretary. On motion of Dr. Nunn the report was adopted.

The resignations of Drs. L. A. W. Alleman, of Brooklyn, N.Y.; A. G. Henry, of Cortland, N.Y.; George H. Rohe, of Baltimore, Md.; A. Lapthorn Smith, of Montreal, Canada, and D. D. Stewart, of Philadelphia, Pa., were read and accepted.

The President appointed Dr. R. Newman, of New York, and Dr. R. J. Nunn, of Savannah, Ga., a committee to escort to the

chair the President-elect, Dr. Charles R. Dickson, which being done, the retiring President, Dr. William T. Bishop, introduced his successor as follows: It is with pleasure that I introduce Dr. Dickson to the Association as their President, and with greater pleasure that I turn over to him, as custodian of the Association, this gavel. When it was presented to me by Dr. Newman, last year, I did not more than half appreciate what he meant when he said it was with "*pleasure*" that he gave it to me. I now know that he was glad to get rid of it. I am also glad to get rid of it. If you have the same success, and are treated with the same kindness and courtesy as I, you will be glad that you have received it, and I hope you will not be glad to get rid of it.

Dr. DICKSON—In accepting this gavel, I must thank you for the honor conferred upon me in making me your presiding officer for the next twelve months. I fully realize what has been said by Dr. Bishop in handing me this gavel. I know that no light task lies before me, and that the President must see that he fall not behind the record of those who have gone before. Dr. Bishop has given in his address a *résumé* of what has been done, and evidently has intended to terrify me with the amount of work which is necessary; but I think I must take courage from the records of my worthy predecessors. I shall earnestly endeavor to fill in a proper manner the office of president, and trust I shall have the active co-operation and assistance of each member of the Association. There is a task before us in revising our Constitution. To carry out the spirit of the resolutions that we have adopted in this respect, may I ask that each Fellow give me his personal assistance and counsel. I trust we may have a profitable meeting next year at Buffalo. There being no further business, I now declare this meeting adjourned, to re-convene at the call of the Executive Council.

The Association adjourned at 12 m.

F. SCHAVOIR, M. D.,
Secretary pro tem.

The President's Address.

By William Thomas Bishop, M.D., Harrisburg, Pa.

In the year 1890, G. Betton Massey, M.D., of Philadelphia, was one of the most active in the initiative movement that resulted in the organization of the American Electro-Therapeutic Association in the city of New York, January 21st, 1891, when Dr. Massey was elected temporary chairman, and later, President, presiding over the first annual meeting, held in the city of Philadelphia, September 24th, 25th and 26th, 1891. William J. Morton, M.D., of New York, presided over the second annual meeting, held in the city of New York, October 4th, 5th and 6th, 1892. Augustin H. Goelet, M.D., of New York, presided over the third annual meeting, held in the city of Chicago, September 12th, 13th and 14th, 1893. William J. Herdman, M.D., of Ann Arbor, Michigan, presided over the fourth annual meeting, held in the city of New York, September 25th, 26th and 27th, 1894. A. Lapthorn Smith, M.D., of Montreal, Canada, presided over the fifth annual meeting, held in the city of Toronto, Canada, September 3rd, 4th and 5th, 1895. Robert Newman, M.D., of New York, presided over the sixth annual meeting, held in the city of Boston, September 29th and 30th and October 1st, 1896. At this meeting William Thomas Bishop, M.D., of Harrisburg, Pennsylvania, was elected the seventh president, presiding over the seventh annual meeting, held in the city of Harrisburg, Pa., September 21st, 22nd and 23rd, 1897. By this recalling of the names of those who have served in the highest official position, together with the places of meetings, much fuller than words express is told the character of our membership, and how generally it is distributed over the American continent.

Having recalled history, let us review some of the transactions, passing through them as a passenger travels the country upon a rapidly moving train, remembering that it is easier to observe defects than to correct them. To all let us say, we are proud of what has been done, and we stand ready to compare our seven years' history with that of any other medical organization in this country for the same period of time.

At Philadelphia, in 1891, too many papers were read, and their discussion was not as full and general as should be desired by the writers. At this meeting, and at all subsequent ones, too little attention has been given to business details. We have trusted too much to some indefinite person to attend to the business matters; and it is but just to say, the first president, Dr. Massey, and the sixth president, Dr. Newman, are the two men who did much to facilitate the organization of the American Electro-Therapeutic Association, to keep it active; but, more than these, their efforts have always been to keep the Association up to a very high plane of useful growth, and in giving just praise to these two honored members, I have not forgotten that we have two others that have been of great service, and to whom not only our Association, but the whole world, owes much, for all have profited by their investigations in the study of electricity and its uses in the service of the medical profession. William J. Morton, M.D., of New York City, and William J. Herdman, M.D., of Ann Arbor, Mich., are the two we now recall. Like the other two, they have served as presidents of our Association. When I recall these names and what they have done for science, I realize how much you have honored me and how little I have done to justify your great expectations; and now, indeed, I feel like saying to my successor, as my friend Dr. Newman said to me when he presented me with the gavel, "It is with great pleasure that I present you with this emblem of your office." My efforts will be to use to my best all that I have for the good of our Association and for your pleasure and comfort while you are in our city.

To every member here let me urge you to influence our absent friends that they meet with us at our next annual meeting. Some of our members require too many personal notices and too many reminders of our meetings. The *Journal of the American Medical Association*, Chicago, and the *Medical Record*, of New York, for one year have kindly published a standing notice of our association, time of meeting, etc. This same information could have been found in our annual volume of Transactions. With these sources of information, "I did not know when the meeting was," is no excuse, as this same thing is frequently told me by members of our County Society, by members of our State Society,

and by members of the American Medical Association. As an officer of our Association I am compelled to admit that the value of medical organization is not fully appreciated by our members.

The membership of all medical organizations must learn that as *medical men* it is their *duty* to be members of the American Medical Association of their State and county societies, and that it is a very great *privilege* to be a member of such a great and useful scientific body as is the American Electro-Therapeutic Association and the other very many associations which we have in our country, each devoted to special study of a single line of medical knowledge. Being members there are added these duties—pay your annual dues promptly, attend all meetings possible, prepare papers, engage in the discussion of papers, reports and the general business, and perform all official duties imposed upon you to the best of your ability. Read the Transactions. If you do all of the above you will be profited and so will others. You will be better qualified for your work, and, I think, will be able to earn more money with less labor than at present. Try it and you will not regret it.

At the second meeting in New York (1892), a number of valuable papers were read, and the foundation steps were taken that have done much to secure some uniformity by the manufacturers, and we can hope that interchangeable parts, by the same manufacturer, may be realized. If that be so, it will be followed by a uniform standard. If the manufacturers will not do it, we must—and let us insist that we will. The original cost will be diminished, the necessity of repairs will be less frequent and less expensive, while these are things to be desired.

The uniformity of the developing power, increased regularity of action, and the additional exactitude secured in every form of instrument will far outweigh any other reasons, and will be the reward of our hard-working committees on scientific investigations.

Please remember that when you accept the reports of these committees it is your duty to defend them. It is your work. The Association has assumed it, the committee is released.

A uniformity of tests and of testing, naturally, will be followed by standard requirements. That in a short time will be followed by the manufacturer accepting them, and then two very troublesome elements will be eliminated. The first to go is the man who wants

an instrument built, the construction of which is well-nigh impossible, while its intended action would be in defiance of all natural laws. "This man is numerous." The second close upon the footsteps of the first, follows in quick succession. This second man is the manufacturer who has an instrument built in such a way that he alone can do it, he alone can explain it; but worse than these, he is the only man who can repair it. This is most unfortunate, as such an instrument needs "constant repairs." Never buy an instrument and a mystery at the same time, for you will be deceived by the mechanical quack, as much so as are the crowds who patronize the vendors of secret nostrums.

The advent of standard instruments is the departure of our two unfortunate friends. We can witness their departure with pleasure, for both have been our tormentors.

In no way would we disparage special skill, for with skill, knowledge and standardization, the instrument constructed has increased uses and durability, and reduced cost, and the item of repair is only a fraction of what it once was.

At the third annual meeting in Chicago (1893), while the boast of strength and vigor was made for our Association, a warning clear and distinct was given to all, that we made and had no claim for a "*new therapeutics*"; but then, as now, we do claim that electricity is a most valuable and potent factor to use, whether used by itself or in conjunction with the remedies of the *pharmacopœia* depending upon the particular case, treating each case as is usual by all practitioners of the regular and rational practice of medicine.

Empiricism has no place with us. Electro-therapeutics of the present is as far removed from empiricism as is the physician of to-day removed from the ignorance and cruelty of past centuries.

Electricity is of the greatest value, whether we use it for *diagnosis*, or for the prevention or cure of disease. For its use we must formulate a good reason, we must know what we desire to accomplish—the dose, so to speak, must be measured.

The use of electricity in the Arts and Sciences has become so general that its application ceases to attract wonder or even observation. In medicine for diagnosis and cure, in surgery for verification of the location of foreign bodies, of the displacement of or restoration of bones, etc., electricity is being used, and so much

more so than ever that I fear that in a measure we forget how valuable an agent we have in use.

The enthusiast who would displace steam with electricity is closely allied to the practitioner who thinks he has found the universal cure, and that he can cut loose from the chemist and pharmacist. Avoid being one-idea men and women. Every thought and means has a use if only properly applied.

The manufacturer, the medical schools and colleges, and the medical journals all show that electricity is of value in our profession. The excellency of work has increased, and the price has been reduced ; durability and usefulness is greater than ever. Much of this has been the result of our Committee and our Association.

Valuable reports were presented, and good papers were read and discussed.

At this meeting the President presented the Association with a *gavel* (it is still in use), a static roller electrode. Upon its surface are engraved the names of those who have filled the President's chair.

At the fourth annual meeting in New York (1894), an amendment to the Constitution was adopted, by which candidates for membership are required to prepare a paper to be read before the Association. The advantages that may possibly accrue are more than overbalanced by the time wasted by the candidate, he not being able to fully know what character of paper he is required to prepare. I say nothing of the loss of time of the Association, which has assembled to receive instruction from practical electrotherapeutists. From the fact that this requirement has not been generally enforced, would it not be as well to repeal this action ? Enforced labor is of little value to a scientific body. Real live active work, the outcome of a living interest, will make men stick to an organization, and secure for us useful members.

The improvement of our nomenclature, the tending towards standardization and the valuable reports presented by our committees upon scientific questions are some of the results accomplished by our Association. These results are the outcome of the joint meetings together of the purely medical man with the purely scientific man, each bringing the result of his labors, his unanswered questions, and his desire of knowledge to our meetings. From all

of the above we have learned very much by mutual exchange, and I hope we have learned enough to know that electro-therapeutists cannot do without the electrical scientific expert, who has aided us so much in our work. Many of the mysteries that confronted each have been revealed; both are met by the unknown. Light, life and thought are active changes; what else, we know not.

Since the organization of the American Electro-Therapeutic Association, colleges, medical and others, have made much progress in teaching electricity. Many more hours are devoted to this important study, and electro-therapeutics is now part of the course of an increasing number of medical colleges; and electrical appliances are necessary to fully equip the hospital of even the smaller of our cities. We have a right to claim that part of this is due to our organization and to the investigations and labors of some of our membership. Be careful that we do not claim too much, and be more careful in adopting reports of committees, so that we do not endorse opinions or admit as facts those things that cannot be proven or defended upon scientific grounds. Better to exclude from our Transactions, when published, all questionable or doubtful matters; or we should publish a general disclaimer of endorsing any published matter.

We should authorize the publication in full of all papers and reports read in scientific session. It is not right to compel the writers of these contributions to science to wait for months, waiting for the Transactions to appear before they are at liberty to give the paper in full. We should ask that with the publication the author's name be given, and that the paper is part of the Transactions of the American Electro-Therapeutic Association. With this privilege comes the duty of being careful whom you admit to membership, elevate to official places or allow to read papers. Discuss all these points, and for good reasons exclude papers if written to advertise the member or exploit some manufacturer.

"Applications" come from many who are graduates in medicine. They are but little removed from being quacks; but I am proud to say these applications are not endorsed by any of our members.

When understood, "varying resistance" may prove to us of

more value than has the Roentgen Ray. It is possible that a *scale of resistance* may prove of more value in diagnosis than has even been claimed for the Roentgen Ray by both the profession and by the laity.

At the fifth annual meeting, held in Toronto (1895), a "standard tip" was adopted. As no measurements are given it was only the design. Imperfect as was this action, it was one step to a standard. The "tip" adopted is of value, and in the selection of president a most notable act was done. One of our first members, and one of our most active members, became President. Robert Newman, M.D., for many years was well-nigh alone in defending electro-therapeutics, and when others gathered around him he was far in the advance of others who taught and used electricity in medical practice.

At the sixth annual meeting in Boston (1896), the address of the President, Dr. Newman, regarding the place electricity occupied in the teaching of the colleges, was a most valuable paper. This, like all of Dr. Newman's work, was complete. This paper and the action increasing the limit for the number of "ordinary fellows" were the most valuable of the Transactions at the Boston meeting.

The lecture by Professor A. E. Dolbear, of Tufts College, was of great interest, of a purely scientific character and advanced thought. Electricity has been used by many who have no knowledge of anatomy, physiology and pathology. This use has brought discredit upon the medical profession and upon the use of electricity for diagnosis or as a remedial measure. The reaction has come, and too much is expected of the X-ray and other modern applications of electricity.

The Harrisburg Academy of Medicine, who own this beautiful building within which we meet, is not a teaching body. All our members are students. By the introduction of members of the medical profession from other places we hope to learn. The Medical Society of the State of Pennsylvania has honored us by meeting four times in the city of Harrisburg, but we are further honored by this meeting of a national body. We know the meeting of the American Electro-Therapeutic Association will be a benefit to us. We hope it will be a pleasure to you all.

Previous addresses of the presidents have only adhered to scientific lines. I thought it best to recall much that has been done, but the time has come for many changes in the business methods. The whole of our organic law requires change. Thanking you for your kindness, I make a few suggestions to the members and manufacturers. Following to some extent the Transactions of previous years has prevented an orderly arrangement, but has shown to better advantage what we have done.

Fuller and more detailed reports of the Secretary and Treasurer should be published. These reports would be guides to new officers and committees in arranging business. The Secretary should be paid a salary.

The Executive Council should consist of six members, two to be chosen each year to serve for a term of three years. The President and Secretary should be, *ex officio*, additional members of the Executive Council, only holding place in the Executive Council during their term of office. Not less than three members should constitute a quorum. The Executive Council should, in addition to their other duties, act as a committee on Scientific Business, to secure papers, arrange for annual meetings, etc. This last duty may be delegated to a local committee.

Life-membership should be provided for.

In the published Transactions the business should be grouped as below: Executive Sessions, Scientific Sessions, Scientific Committee's Reports, List of Members, and Full Index.

Advice to the member who wants an instrument for an untried purpose:

Find out the result you desire to accomplish, fix the price you expect to pay, and you can depend upon the manufacturers either telling you that the result cannot be reached, or that the price is inadequate; or that you will receive the instrument just as you want it, providing you do not change your mind too often.

In selecting instruments it will be much better to depend upon the results obtained by disinterested committees, than to listen to the seller of a complex and expensive instrument that he will not present for comparative testing with the instrument of rival manufacturers. Learn to take care of your instruments and you will learn much about using them. I do not say that you

should do it, but learn so you can do it. This will pay you by knowledge gained, and by the increased durability and lessened repair of your instrument. Dosage by patient is just as useless and provocative of danger to the patient and loss of patient to the doctor as is the refilling of prescription or counter-prescribing. Both of these we complain of, and for both we are in a measure responsible. Always keep instruments etc., clean; use no unnecessary force; do not increase the patient's nervous disturbance; do not minimize a patient's ailments. Street current, by use of transformer, or as motor for engine, may now be used; both uses are advocated by some.

You all know the honor of being president is appreciated, but I fear but few realize the amount of labor that it is necessary for the President and Secretary to perform; this allusion is made so as to justify the changes suggested.

To the manufacturers. We want you to know, beyond any question, our committees cannot exploit one instrument and condemn another because of their likes and dislikes. When the reports of our committees upon scientific questions are read and adopted by our Association, the Association assumes the responsibility, and the committee is released or relieved from personal responsibility.

If we have erred in adopting the report, prove our mistake or improve your instrument. Our exhibitions are open to all manufacturers. We invite you to come and exhibit, or to send your instruments for comparative tests by our committees. Standard tests and standard instruments are what we want to secure uniform results. As the instruments are improved a more exacting standard may become necessary.

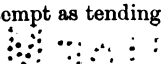
All that has been said has been for the good of the Association and the benefit of the medical profession.

Report of Committee on Meters.

Read by MARGARET A. CLEAVES, M.D., New York, Chairman.

The Committee on Meters begs to submit the following report, covering the results of the work which has been done by it during the last year. It is with a feeling of gratification that the committee finds a disposition on the part of manufacturers of meters to do their utmost to accommodate the committee, and to adapt their instruments to the needs of the profession. It is also a matter of interest that several makes of meters have been withdrawn permanently from the tests of the committee, because of their demonstrated inefficiency. The following manufacturers submitted meters for examination and test by the committee: Weston Electric Instrument Co., Edison Manufacturing Co., J. C. Vetter & Co., Chloride of Silver Dry Cell Battery Co, Jerome Kidder Manufacturing Co., McIntosh Battery and Optical Co., and the Keystone Electrical Instrument Co., of Philadelphia. Each of these manufacturers had a representative present at the test, with the exception of the Chloride of Silver Dry Cell Battery Co. The Keystone Electrical Instrument Co. is a new recruit in the ranks, placing on test a milli-ampere meter and a volt meter, each adapted for use in connection with alternating currents, both the sinusoidal and the interrupted or faradic.

THE SELECTION OF A STANDARD METER.—The criticisms which were made at last year's convention of the committee's action in selecting the Weston meter as a standard during the test, were considered by the committee to have been unwarranted by the facts. It will be remembered that a statement was made that scarcely any two Weston instruments placed on the same circuit would read alike, and that the Thomson balance was the only standard which should be used. The committee also regretted that a meter manufacturer, who had been accorded the privileges of the floor, should have taken advantage of the opportunity to attack the makers of a meter whom he considered as his rivals. The Committee on Meters earnestly protests against this or any similar attempt as tending to lower the dignity of the Association. The



committee also protests against the justice of allowing such remarks to be published in the minutes.

An examination of the tables accompanying the previous reports of this committee will show that, as a matter of fact, the Weston instruments subjected to test correspond with each other with great closeness. These reports also show that a comparison of the Weston instruments with a Thomson balance, such comparison being made by Professor F. B. Crocker, of the School of Mines, Columbia University, New York City, 1894 and 1896, also demonstrated the accuracy of the Weston instruments. Professor Crocker was communicated with this year to find whether it would be possible for him to again make such a comparison. It was found that the removal of the university to its new quarters would preclude the possibility of making such a test. In his letter regretting the necessity of declining for this reason to repeat his gratuitous and cheerful service of last year, Professor Crocker writes: "In regard to the Weston instruments, I can say that I have the highest opinion of their accuracy; in fact, I hardly think it is necessary to verify them. If I had two of them, and their indications agreed, I should feel practically sure that they were correct. As a formality or extra precaution, it might be desirable to standardize them, but I do not think there is any real necessity for it." Professor Crocker thus officially expresses the view which is, we believe, held by other eminent electrical engineers and by the electrical trade generally.

The committee has taken occasion to investigate the methods employed at the Weston factory, in Newark, N.J., for standardizing their meters. It is found that this factory is better equipped with Thomson balances, standard resistances, standard sources of electro-motive force, etc., than any other institution in this country. There are several independent devices of a given standard, and frequent and careful comparison is made between apparatus standardized at the same point for the purpose of checking the accuracy of each. It has been ascertained by the committee, that although the Thomson balance may be considered a true standard at the particular point at which it is standardized, there is an element of error which increases as the square of the departure from that point. This means that if a Thomson balance is

standardized at 50 milli-amperes, there may be an error in low readings or high readings of this apparatus, of 5 or more per cent. As the scale of the Weston instruments is almost exactly proportional throughout its entire range, it follows that if the meter corresponds with the Thomson balance at the point where the latter was standardized, then the Weston instrument will be correct throughout its scale.

Capacity of Milli-ampere Meters.—The committee has on several occasions in the past called attention to the undesirability of making a meter for direct currents reading higher than 100 milli-amperes. We now desire to again emphasize this position. Enlarged experience in clinical and office work shows that the occasions for the use of larger applications than 100 milli-amperes are extremely rare—so rare, in fact, as not to compensate for the general loss in efficiency of operation of the meter. A meter having a scale of 100 milli-amperes will permit of a more convenient marking and much greater convenience in use. As we have stated before, it rests very largely with the meter manufacturers to bring about this result, but it also is desirable that the members of the profession should realize the decided advantage, for general practice, of a meter having the low range above indicated. The conditions are exceptional where higher readings than 100 milli-amperes are required. Among them have been mentioned in previous reports the treatment of malignant growths and general hydro-electric applications. The average practitioner is not equipped for the latter, and it is the exception that the electro-therapeutic specialist has the opportunity of treating malignant diseases.

This will mend itself in time, but meanwhile the efficiency of the meter used by the mass of the profession should not be interfered with for the sake of an occasional instrument required for special purposes. Such an instrument can easily be secured when needed.

In the Apostoli treatment of fibroids with an available E. M. F. of 50 volts and a current flow of 100 milli-amperes, energy is expended at the rate of 5 watts, 3.6866 foot pounds per second or .0067 of a horse-power. If continued over a period of 600 seconds there is expended in the tissues a total energy of 3,000 joules,

2211.96 foot pounds or 4.02 horse-power seconds. When we come to calculate the rate at which we do our work and the amount of work done in the tissues, we will not only be less prone to insist upon so great an expenditure of millivolts per ohm of resistance, but we will more nearly approach true scientific methods.

In regard to the criticism made upon the one way reading, the committee beg to say that it is no disadvantage even to the neurologist, for with the pole changer with which every switch-board is equipped the direction of the current can be changed between the meter and the patient without the readjustment of the electrodes. Much is sacrificed in clearness of scale by a double scale, and the committee can only reiterate the opinion heretofore expressed in favor of having the instruments register with the current flowing only in one direction.

The Test.

The test on meters was made at the office of Dr. Margaret A. Cleaves, on Tuesday, September 14th, 1897. Dr. Cleaves and Mr. Hammer of the committee were present, and also the following gentlemen: Mr. Beneoky, of the Weston Company; Mr. Hedgmann, of the Edison Manufacturing Company; Mr. Wappler, of the J. C. Vetter Company; Mr. Livingston, of the Jerome Kidder Company; Mr. Jewell, of the McIntosh Company; and Mr. Stevens, of the Keystone Company. The eight meters in the test were placed in series with each other, and current was passed through them from the Edison street circuit, the variations in current being obtained by manipulation of appropriate resistances. The results of the test are indicated in the attached table, and it may be well to make the following remarks concerning the instruments tested:

Weston Meter.—Only one Weston meter was submitted to the committee this year, and the technical assistant of Mr. Weston was sent with it as the representative of the Company.

The instrument was one reading from 0–150 milli-amperes and showed some slight modifications over the type heretofore employed. These changes have not been in principle, but in such details as the finish of the case and the arrangement of some of

the parts ; the result is a beautiful instrument. It will be understood that this meter is of the type which has now become so familiar, with a powerful permanent magnet, between the poles of which moves a coil of wire through which passes the current to be measured. The committee is informed that there is in process of manufacture a style of Weston instrument which will be sold at a much less price than the present high-class instrument. The cheaper meter, however, will not be ready for the market for some months to come.

EDISON MANUFACTURING COMPANY'S METER.—Two of these meters, of the style devised by Mr. Kennelly, were on test. One was a meter reading from 0–200 m.a., which had not been restandardized since 1893, and which has been in constant use ever since. The other meter had a scale from 0–100 m.a., and was submitted for test by the makers. From the table of tests it will be seen that there was quite a close correspondence between these two meters and the Weston, but only above 5 m.a. The older meter did as well as the newly calibrated one, and this would seem to suggest that, as heretofore urged, greater care be taken by the manufacturers in the calibration of their meters. This meter is also of the type having large permanent magnets with movable coil.

VETTER METERS.—There were two Vetter meters submitted for test. One was designed for the use of dentists, and had a scale reading from 0–5 m.a.; the other instrument was a modification of the type exhibited by this firm last year, in which a volt meter and milli-ampere meter are combined on one base. The milli-ampere meter had two scales, one reading from 0–20 and the other from 0–200 m.a. Last year's instrument was held in an upright position on a standard; this year's instrument was placed in a horizontal position, and was supplied with a soft metal fuse wire in series with the milli-ampere, which it is intended shall melt should an excessive current accidentally pass through the circuit to the patient. The committee does not look favorably upon this device, as it is necessarily of uncertain action, and its presence would tend to carelessness on the part of the operator. While the Vetter instruments appear to be well constructed, and are really very attractive in appearance, and are, moreover, of the heavy permanent magnet

type, the results which the committee have been able to secure are such as to indicate the lack of proper standardizing methods during manufacture. Too much care cannot be taken in this respect.

CHLORIDE OF SILVER METER.—There was one meter of this make submitted for test. It was of the galvanometer type submitted last year, and had three scales, viz., 0–10, 0–50 and 0–250. These three scales were placed on a cylinder which could be rotated to bring one scale after another into view. While this instrument has a "dampener" for protection during transportation, and a device for magnetically adjusting the needle to zero, it is the opinion of the committee now, as in the past, that this type of instrument hardly comes up to the requirements of a careful operator. The shape of the scale, the shape of the needle, a susceptibility to external magnetism, the necessity for zero adjustment with each change of scale, the inaccurate calibration, all militate against its usefulness. If it is possible to remedy these defects the committee earnestly recommends to the manufacturers that they take steps to this end.

KIDDER METER.—One of these instruments was submitted for test, having a scale ranging from 0–120 m.a. It was with great pleasure that the committee observed the care which had been apparently taken to overcome defects existing in prior apparatus, and in their ability to submit for test an instrument which corresponded with the standard with almost absolute closeness throughout the entire range of the instrument. The meter is of the galvanometer type, can only be used in a vertical position, and may possibly deteriorate in accuracy with a passage of time, but it is the best instrument of this class which has ever been brought to the attention of the Committee on Meters.

MCINTOSH COMPANY METERS.—Three McIntosh meters were submitted to test, having scales reading as follows: 0–100, 0–150 and 0–5 m.a. These instruments have been changed in general appearance since last year. Instead of having a top scale and an edgewise scale there is now only the former; it is believed this change is advantageous to the instrument. The 0–100 and 0–150 m.a. meters have the double scale (reading on one side or the other) with the current passing in either direction. The meter reading

from 0–5 m.a. is for dental purposes, and reads with the current passing in only one direction.

The McIntosh dental meter corresponded with the standard throughout its range, but the other McIntosh meters showed a wide variation, particularly above 30 milli-amperes. As compared with several of the other meters, the meter with the scale of 0–100 was found to be 5% high at 20 m.a., 1½% high at 50 m.a., and 5% low at 100 m.a.; the meter with the scale of 0–150 was found to be 5% high at 20 m.a., 6% low at 50 m.a., 10% low at 100 and 150 m.a.

Volt Meters.—The Edison Manufacturing Co. submitted a volt meter for test having a scale from 0–150 volts. The J. C. Vetter Co. submitted (on the same base with the milli-ampere meter) a volt meter having two scales, viz., 0–15 and 0–150 volts. The McIntosh Co. submitted a Jewell volt meter with scale from 0–300 volts. The Weston Co. did not submit a volt meter, but one which had been in use for a long while without recalibration was used for purposes of comparison. The following observations were made:

Weston.....	75 volts	100 volts	120 volts.
Kennelly.....	..	98 "	..
Vetter.....	..	105 "	..
Jewell	75 "	100 "	120 "

At the close of the test the Weston volt meter was sent to its maker, and it was found that the true reading was practically one volt below that observed. The readings, then, should be altered as follows:

Weston.....	74 volts	99 volts	119 volts.
Kennelly.....	..	98 "	..
Vetter.....	..	105 "	..
Jewell	75 "	100 "	120 "

Queen Company's Meter.—This company informs the committee that they are desirous of being in the market with a meter, but write, "Not until we can present an instrument which we can thoroughly guarantee. Our present instruments, although past the

experimental stage, have some work to be done upon them in order that they should reach the truly commercial form." The committee hopes that this company shall, at a later date, feel able to present apparatus for consideration.

KEYSTONE ELECTRICAL INSTRUMENT COMPANY'S METER.—The Committee on Meters has been striving for several years to arouse the meter manufacturers to the consideration and development of milli-ampere meters and volt meters for use on the alternating current circuits, both the sinusoidal and the interrupted or Faradic. In the last report some reference was made to instruments used for this purpose abroad, and it is with feelings of the greatest satisfaction and pleasure that we are able to announce that the Keystone Company has perfected apparatus for these currents. The company submitted a sample milli-ampere meter and volt meter to the committee for examination and test, and has promised to also submit a watt meter for use on similar circuits in time for examination at this convention of the Association. The committee has examined the meters submitted, and is much pleased with the results obtained. While not having any means at hand for determining the absolute accuracy of calibration of the meters, the committee is reasonably assured as to the, at least, approximate accuracy of such calibration. This being the case, it is possible for the physician to now make observations in terms of volts and milli-amperes, instead of in the indefinite manner heretofore necessarily employed, which has usually been stated about as follows: Induced current primary or secondary; slow or fast, interruptions, as the case may be; 1,800, 1,500, 1,200, or less, yards or number of turns, regulated through the rheostat to the patient's toleration. Or, in the case of a millimetre scale, by indicating the number of millimetres according to the position of the secondary over the ordinary coil. The meaning of this, such as it had, varied with the different make of coils.

Mr. J. F. Stevens, the engineer of the Keystone Company, who has been particularly connected with the development of these meters, has written a description of his apparatus, which is of such interest that the committee feels it wise to embody it in this report in its entirety. This statement has been written since the date of the test:

"At the request of Dr. Margaret A. Cleaves, of New York, our company some months ago undertook the investigation of the subject of milli-ampere meters for use on the interrupted or faradic, and sinusoidal alternating current circuits now so much used by electro-therapeutists. We found that up to the present time no instrument had been designed for this class of work, which was suitable for use by practical operators. While it is true that Messrs. Kipp & Zonen, of Holland, have exploited an instrument for this purpose, it is extremely delicate and would prove in the hands of any but skilled experimenters too difficult to handle; and this, aside from the fact that it contains iron (always a detriment in instruments of this character), and requires time and patience—more of the former than is usually at the disposal of the busy practitioner—to obtain readings reasonably accurate and reasonably free from errors depending on the 'personal equation.'

"There are now on the market a number of milli-ampere meters, for use on the direct or galvanic circuit, which are reasonable in price and sufficiently accurate for all practical purposes. These instruments possess many qualities which it seemed desirable to incorporate in a similar instrument for use on the interrupted or alternating current, and we believe we have covered all but one (the uniform scale from zero to maximum scale) and have added several which we feel possess some merit.

"The system which we adopted, and which we submitted for practical test after considerable experimenting in our laboratory, is based on the dynamometer principle. By the employment of this system we are able to obtain readings in *virtual* or *effective* milli-amperes, the now accepted standard for alternating or interrupted current work. That is, a dynamometer measures directly the square root of the mean square of the current flow; it integrates the current pulse and gives readings in terms of the unidirectional, non-undulating or galvanic current. Its indications, if the system is properly constructed and with the proper ratio of turns in fixed and moving coils, are entirely independent of the wave form. It at least forms a basis for comparison, so that current administered may be referred to a standard indication and the same results attained no matter what form of alternator or Faradic coil may be used.

"It is not our province to refer to the necessity of such a basis of comparison, but rather to treat of the instrument by which it may be attained.

"The instrument submitted to Dr. Cleaves and afterwards shown the Committee on Meters, read from five to fifty milli-amperes. We found it impracticable to extend the lower range below five milli-amperes without introducing many undesirable features, and are inclined to believe that the minimum division will be found low enough for all practical purposes. Should we attempt to show indications below five milli-amperes it would be necessary to support the moving coil by means of a filar or bi-filar suspension, which would involve the insertion of a galvanometer suspension tube and make it necessary to carefully level the instrument before taking readings. Further, it would be difficult to damp the oscillations of the needle sufficiently to permit reasonably rapid readings without introducing probable errors which might prove quite serious.

"The instrument, as we finally designed it, is mounted in a mahogany case and provided with a carrying handle, so that it is easily transportable. It is not in the least affected by external fields, unless used on the galvanic circuit, when it is advisable to take readings with the current flowing first in one direction through it, then reversed, and the mean reading used. Readings are entirely unaffected by temperature changes, are direct and all indications dead-beat, that is, the point will respond quickly to changes of current without oscillations. The resistance of the instrument is about 200 ohms for the scale reading given above, but this will not affect indications and is but a slight increase of the total resistance in circuit, requiring only a small increase in the electro-motive force to send the same amount of current through.

"Through the courtesy of Dr. Cleaves we were permitted to make a number of practical tests and see copies of clinical reports, from which we were convinced that not only are records of current strength desirable, but also records of the electro-motive force, from the combination of which the work done in watts may be computed. We therefore, by means of an instrument similar in character, but of high resistance and intended to be used in shunt

to the circuit, read the actual volts employed in sending a given current through the body. So, then, by the use of these two instruments full records of work done may be obtained on the faradic, or alternating current, the same as is now the acknowledged practice in galvanic applications.

"In order to simplify the work for the practitioner, we now propose to offer in one instrument a combination of these two in the shape of a watt meter. By means of such a watt meter the total energy expended on a subject may be read directly from one instrument, and by multiplying by the time of application the total work done ascertained. The range of the watt meter we propose to submit for practical test will be two watts, reading from two-tenths watt to full scale. This means that it will indicate the energy with from five to fifty milli-amperes of current flowing at a potential up to forty volts. This range seems to cover all contingencies as we know them at present, and we are quite ready to modify either factor should practice dictate any advantage in so doing.

"The construction of this watt meter will be in general the same as the milli-ampere meter or volt meter already tested, the difference being that the fixed coils will be energized by the current flowing, while the moving coil, in series with a non-inductive resistance, will be in shunt to the circuit. Therefore there will be four binding-posts on the instrument—two for the voltage readings, which will be in shunt to the circuit, and two for the current readings, which will be in series with the circuit, the combination of these two giving readings directly in watts. We may note in passing that in this instrument the resistance in the series circuit will be about half that of a milli-ampere meter of corresponding range. It may be well to add that the current and pressure coils will contain so nearly the same number of turns that there will be no chance of error by reason of phase displacement. Further, we would say that no iron or magnetized steel is incorporated, and in general nothing subject to change. We also take great care not to have any continuous metallic circuits in the case, frame or system, so that errors due to secondary or induced currents are avoided.

"We would like to have it understood that in all work of this kind with which we may be entrusted, it will be our aim to

produce only thoroughly reliable instruments made and calibrated in the most careful manner. Every detail will be closely watched, for we feel that a considerable responsibility will rest on us in attempting pioneer work in this line. We could not afford to mislead the profession in any way, and we will at all times welcome suggestions or criticisms from practical users."

In closing this report, the committee wishes to state that while recognizing to the full the importance of the tests which have been made from year to year of instruments submitted by manufacturers for that purpose, and realizing the general improvement in the meters on the market resulting, as the committee believes, from the effect of its labors, there is an element lacking which, if supplied, would put the committee in possession of very important data. The committee believes it is a vital matter that the manufacturers should submit for its constant observation such meters as the manufacturers desire to place before the profession. It is one thing to know the accuracy of a meter immediately after calibration; it is an entirely different matter to observe the action of the meter during an extended period subsequent to such calibration; apparent defects at the time of an original test may be shown to be defects of calibration of the individual meter rather than a fault of the class which it is supposed to represent. The committee believes that it would be to the interest of all the manufacturers who have heretofore submitted their meters for a temporary trial, to now send to the committee samples of their instruments, to be observed between this time and the next convention of this Association.

In order that the Association may have in convenient form a statement as to the results of all of the tests which the Committee on Meters has made up to the present time, it has been thought wise to append to this report copies of the tables which have appeared as part of such reports in the past.

Respectfully submitted,

(Signed,) MARGARET A. CLEAVES, M.D.
Chairman Committee on Meters.

EDWIN W. HAMMER, E.E.
CALEB BROWN, M.D.

METER TEST OF SEPTEMBER 12TH, 13TH AND 14TH, 1893.

Resistances in Series with 20 Cells Leclanché Battery and Meters.	*Internal Resistance.*	*Readings in Milli-Ampères.*										
		4800	2720	1710	1400	1050	650	475	310	220	136	91
Weston—												
Scale 0–10	16.599	6	10	..	..	..	..	..	..	..	..	..
" 0–500.....	.362	..	..	15	20	25	40	50	75	100	150	200
" 0–300.....	.199	6	10	15	20	25	40	50	75¼	100½	153	201
Kennelly—												
Scale 0–200..	1.30	6	10	15	20	25	40	50	74¾	99½	149	199½
Queen	*	5¾	9½	15	20	25¾	43¾	52	..	..	..	..
Vetter.....	*	6½	10¾	16	21	31	45	62	89	115	168	218
Flemming.....	*	5½	8½	15	20	28	36	46	68	88	160	220
Waite & Bartlett.....	.130	6½	12	19½	24	36	50	65	89	120	195	210
Galvano-Faradic	*	5½	9	13	17	24	35	40	68	90	145	200
Gaiffe.....	*	5½	8	13	17	25	34	40	..	..	..	..

* Not given.

Make of Instrument.	*Scale.*	*Milli-Ampères Read in Test.*															
Weston	*0-10	1½	2	3	4	5	8	10	..	..	..	..	..	.	..	..	..
	0-150	..	2	3	4	5	8	10	25	50	75	100	150	..	..	..	..
	*0-500	..	..	..	..	..	..	..	25	50	75	100	150	200	250	300	500
Kennelly †	0-100	1½	2	3	4	5	8	10	25	50	75	100	..	..	..	..	..
	0-200	..	..	..	..	..	8	10	25	49½	72½	96½	132½	178½	..	..	..
	0-200	..	..	..	..	..	8	10	24½	50	75	99½	142½	187½	..	..	..
	0-500	..	..	..	..	..	..	..	23	49	74	100	150	200	250	300	499
Kidder	*0-75	1½	2	3	4	5	8	10	25¼	50¼	75½	..	..	..	..	..	..
	*0-300	..	..	..	..	..	..	..	..	..	..	101	157½	211	260½	309½	..
Queen	*0-25	1½	2	2¾	3¾	4¾	5	7¾	23¾	..	..	..	..	..	..	..	..
	*0-250	..	..	..	..	..	..	..	..	47	73	92	138	190	240	..	..
	0-250	..	..	..	..	..	..	..	..	37	50	67	95	153	165	..	..
Hirschmann	*0-5	1¼	1¾	2½	3⅓	4¼	..	..	..	..	..	..	..	..	..	..	..
	*0-50	..	..	..	..	..	7	8	20	40	..	..	..	..	..	..	..
	*0-250	..	..	..	..	..	..	..	..	..	62	82	125	162	220	..	..
Waite & Bartlett	0-250	1½	1¾	2½	3⅓	4	7	8½	22	43	68	90	135	190	250	..	..
McIntosh	*0-20	1	1½	2¼	2¾	3¾	5¾	6¾	17	..	..	..	..	..	..	..	..
	*0-1000	..	..	..	..	..	..	..	..	30	49	60	80	110	140	160	250
Vetter	*0-50	1½	1.8	2¾	3¾	4½	7½	9¼	23	45	..	..	..	..	..	..	..
	*0-500	..	..	..	..	..	..	..	..	..	72	90¾	138	185	240	280	460
Flemming	*0-10	1½	1.8	2¾	3¾	4½	7½	9¼	..	..	..	..	..	..	..	..	..
	*0-100	..	..	..	..	..	..	..	23	47	72	92	..	..	..	..	..
	*0-1000	..	..	..	..	..	..	..	.	..	..	..	150	200	260	315	520

NOTE.—The scales of each make of meter with a star (*) are on the same instrument; it is thus shown that there were two Westons and one Flemming instrument in the test, etc.

† This Kennelly meter has been in constant use a year without re-standardizing.

METER TEST OF AUGUST 28TH, 1895.

Meter.	*Scale.*	*Corrected Test Readings in Milli-Ampères.*																	
Weston	0–300	13	15	20	25	30	40	50	60	75	100	125	150	200	250	300	..	..	..	..
"	0–500	13	15	20	25	30	40	50	60	75	100	125	150	200	250	300	350	400	450	500
Kennelly	0–500	13	15	20	26	30	41	52	61	76	102	128	151	202	252	300	351	401	451	501
"	0–200	13	15.5	21	26.5	31.5	41.5	52	61	76	95	125	147	191	..	..	..	..	..	..
"	0–100	14	16	21¼	26¾	31.5	41.5	51.5	61.5	76	97.5	..	..	..	..	..	..	..	..	..
McIntosh	0–150	13	15	20	25	30	39	48.5	57.5	71.5	97	112.5	..	..	..	..	..	..	..	..

METER TEST OF SEPTEMBER 22ND, 1896.

Weston	0–150	12	15	20	30	40	50	75	100	125	150	..	..
"	0–500	12	15	20	30	40	50	75	100	125	150	200	250
"	0–1000	..	..	20	30	38	50	75	100	125	150	200	250
Kennelly	0–100	12	15	20	30	39¾	49½	74½	98	..	..	..	..
"	0–150	12¼	15¼	20½	30¼	40	50	74¼	99¼	123	148	..	..
Chloride	0–10	..	..	..	..	..	..	..	..	..	..	..	..
"	0–50	12	15½	21	31	43	..	..	..	..	..	..	..
"	0–250	..	..	..	..	..	52	80	110	135	165	225	..
Jewell.....	0–300	11	14	19½	28	37½	47	70	94	..	..	..	..
McIntosh...	0–300	12½	14	19½	29	38	49½	74	97½	125	148	200	275
Kidder	0 50	12	15¼	21	30¼	40	50½	..	..	..	..	..	..
"	0–250	..	..	..	..	..	50	75	98	125	148	205	252
Vetter	0–25	12¾	16¼	21½	..	..	..	..	..	..	..	..	..
"	0–250	..	..	..	32	40	52	78	108	129	152	212	251

METER TEST OF SEPTEMBER 14TH, 1897.

Meters.	*Scales.*	*Milli-Ampère Readings.*																				
Weston	0–150	**1**	**2**	**3**	**4**	**5**	**8**	**10**	**15**	**20**	**30**	**40**	**50**	**60**	**75**	**100**	**120**	**130**	**140**	**150**	..	..	..
Kennelly	0–200	1	1.9	2.8	3.9	4.6	8	10	16	21	31.2	41.5	51	59.5	75.5	100.5	120	130	140	150	**160**	**180**	**200**
"	0–100	1	1.7	2.25	3	4.6	7.7	9.6	14.6	19.5	29	38.8	48.8	58.6	73.5	100	..	..	..	..	..	..	..
Vetter	0–5	.8	2.4	4.3	5	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
"	0–20	.8	1.8	2.8	3.8	4.8	7.8	9.8	14.8	19.8	..	..	..	..	..	..	..	..	..	..	..	..	..
"	0–200	..	..	..	..	..	..	..	..	..	29	39.5	49.9	60	74	98	116	126	136	145	156	177	198
Chloride of	0–10	1.3	2.4	3.6	5	5.5	9.5	*	..	..	..	..	*	..	..	..	..	.	..	..	..	..	..
Silver ...	0–50	..	..	..	..	..	..	..	18	23	36.5	46		..	..	..	..	..	..	..	..	..	..
"	0–250	..	..	..	..	..	..	..	..	..	..	..	..	..	..	130	160	170	175	190	200	225	250
Kidder	0–120	1	2	3	4	5	8	10	15.2	20	30.5	40	49.8	60	74.5	100	119	..	..	..	..	..	..
McIntosh ...	0–100	1.	2	3	4	5	8.2	10.5	15.8	21	32.2	42.5	53	62	76	95	..	..	..	..	..	..	..
" ...	0–150	1	2.1	3.25	4.2	5.3	9.4	10.8	16	21	30	39	47	56	69	90	115	120	125	135	..	..	..
" ...	0–5	1	2	3	4	5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

* Off Scale.

NOTE.—The scales enclosed by brackets are on the same meter. Heavy-type figures show standards used.

NOTE.—Since making the tests and preparing the above report, there has been submitted to the Chairman of the Committee, by Mr. J. S. Stevens, of the Keystone Electrical Instrument Company, the watt meter mentioned in the report. There has as yet been no opportunity of using it in practical work, because of the lateness of the hour at which it reached New York. As it is advisable, however, to administer a given amount of current for a given case, and as the resistance through which this current must be forced will vary with different patients, and possibly also with the physical condition of the patient, the E. M. F. must be varied, so that the watt indication would not always be a true indication of the amount of current administered. Therefore, the committee are of the opinion that in the combination of volt-meter and milli-ammeter, the development of true scientific methods will best be secured. The chairman desires to state here that she has the three instruments with her, viz., a portable volt meter for alternating currents of rather a high range, for which one of lower range is to be substituted ; a milli-ampere meter of from 5 to 50 m.a., and a watt meter with a scale of from 2-10ths to 2 watts. These instruments the chairman will take pleasure in showing the Fellows of the Association at some convenient opportunity.

DISCUSSION.

Dr. G. B. MASSEY, of Philadelphia, Pa., moved that the report be adopted, and in doing so expressed for the Association the appreciation of the scientific zeal evidenced by this report. The matter of meters, he said, was a turning-point in electro-therapeutics—a turning-point from darkness to light. One who uses a meter which is not properly calibrated, is still groping in the dark, and hence the vast importance of the work of this committee. The committee had shown that the ordinary vertical meters were constantly liable to deterioration, and the meters of the galvanometer type were liable to become over-sensitive. Regarding the assumption that practitioners should be bound down to the use of a meter which would not register the amount required in individual, though perhaps exceptional, cases, he said that such an assumption was a gratuitous and unnecessary criticism. He was not aware that any of their number had been guilty of using injuriously large doses. This was a matter of clinical experience, and could not be decided off-hand by any one person. The dosage must vary very greatly in the treatment of different classes of patients, and must be determined by practical clinical experience and not by theoretical calculations and deductions.

Dr. R. J. NUNN, of Savannah, Ga., in rising to second the motion of Dr. Massey, said that he thought the protest of the committee regarding the publication of the discussion on the merits of different meters was very well taken. He also stated that while it was true that a high current was often required, one should not overlook the fact that a mild current continued for a long time would accomplish the same result. Regarding the term "watt," the speaker said that the term by itself expressed nothing; we should state also either the voltage or the amperage. As he understood, the watt was the result of the multiplication of the volt by the ampere; therefore it was evident that 10 amperes multiplied by 10 volts, would equal 100 watts; also that 20 amperes multiplied by 5 volts would give the same number of watts. The fact that an instrument registered correctly at one point—say, at 50—was not, in his judgment, any authority for the assertion that it registers correctly all through the scale. For example, a clinical thermometer was usually furnished with a table of corrections for the different portions of the scale. As to the suggestion of the committee regarding the change in the value of the readings by the age of the instrument, he said that he would suggest that the committee should establish a bureau of calibration for the benefit of members desiring to have their meters tested and readjusted. He did not think that Dr. Massey's criticism on low and high registration was well founded, for the committee did not recommend that a high current should not be used; but it did say—and we must accept its verdict, he thought—that the same instrument would not accurately register a low current and a high one.

Dr. CLEAVES explained that this was not strictly correct. The committee felt that much of the usefulness of the instrument was sacrificed (*e.g.*, the clearness of the scale) by the use of a high-reading scale. It was the exception for the electro-therapeutist to need a high-reading instrument.

Dr. MAX EINHORN, of New York, moved that the Association tender a vote of thanks to Dr. Cleaves for the very painstaking report presented. Seconded by Dr. Newman, and carried.

Report of Committee on Electrodes.

By C. R. Dickson, M.D., Toronto, Canada, Chairman.

I have to present a form of binding-post devised by one of our members, Dr. Lucy Hall-Brown. It is a split-post connector, with spiral spring holding a sliding collar, and its special merits can best be appreciated by examining it. In addition to a vertical hole for the standard "Association" tip, it has a horizontal hole in which the various sizes of existing tips may be held securely by means of the sliding spring collar.

A letter has been received from the Jerome Kidder Manufacturing Company, of New York, by Dr. John Gerin, of Auburn, N.Y., expressing the wish that the Association would select some standard diameter for the hole to be drilled in binding-posts and the plug or stem to suit; advising the Association to select some decimal part of an inch, such as the universal standard of Brown and Sharp, for the reason that all mechanics could readily secure tools for the construction of such standards, which were more convenient for the measurement of small parts than the French metric system, which latter was usually a circumference, rather than a diameter measurement, particularly in medical work.

The letter also called attention to the advantages of the binding-post exhibited; advocated the use of binding thumb-screws as the most perfect means of connection; and suggested that the Association adopt the American standard screw threads, in order that screws lost might be replaced without difficulty.

Our committee has already recommended the adoption of the metric system of measurements, and we hope the recommendation will be endorsed by the Association. M. Gaiffe, of Paris, has expressed a willingness to make instruments in conformity with our standard, provided the metric system be adopted by this Association.

(Signed,) C. R. Dickson.
J. Gerin.

Dr. R. Newman, of New York, moved that the report be adopted. Seconded and carried.

Dr. J. Gerin, of Auburn, N.Y., moved that the Association accept the recommendation of the committee regarding the adoption of the metric system for all measurements. Seconded by Dr. G. B. Massey, and carried unanimously.

Report of Committee on Electric Light Apparatus for Diagnosis and Therapy, and the Roentgen X-Rays.

By Frederick Schavoir, M.D., Stamford, Conn.

Concerning electric light apparatus for diagnostic purposes there is little of importance to report, as nothing of special interest has been developed during the past year. There has been a tendency shown by manufacturers to reduce the cost of apparatus so as to induce more sales—notably, one firm, the American Endoscopic Company, of Providence, R.I., has made a special effort in that direction. They furnish a urethroscope, consisting of three sizes of sounds, with lamp and reflector attachment, and four dry cells, for six dollars. The apparatus is well made, and really very cheap; all their other apparatus is on the same line. It is only natural that the X-ray apparatus should receive a great deal of attention, being such an epoch-making and recent discovery. I might say that nearly all the eminent physicists and electricians are busying themselves with this wonderful phenomenon, yet during the last year there has been but little brought out which interests us in a practical way. There have been numerous improvements in the construction of apparatus, but no vital addition has been made to the knowledge which we possessed. It is my conviction that the X-rays produced by means of a static machine are by far the most penetrating and steady, and by the aid of a static machine, radiographs are produced in a much shorter time than by the other generators.

The eight-plate static machine, as manufactured by several firms in New York City, is to my mind the most satisfactory means of generating or rather exciting the X-rays. The advantages of the static machine over coils are manifold; it is always ready and of highest efficiency, there are no batteries to be looked after, it is a therapeutic agent, and therefore fulfils a double purpose. The cost of running it is almost nil.

As for the Crooke's tubes, a number of improvements have

been devised, and there is an enormous difference between the original Crooke's tube and one of the latest productions.

Mr. Edison and Prof. Elihu Thomson have given us in short succession new models, the last always somewhat superior to its predecessor. From the original tube the single focus tube was evolved ; then the double focus tube appeared, and the very last is so arranged that the vacuum can be controlled by the aid of an auxiliary tube containing a chemical capable of generating gas when heated, which will reduce the vacuum sufficiently to restore a tube to its normal functions. The Fluoroscope has not materially changed. The tungstate of calcium screen is the one generally employed ; however, there has been a marked improvement in transparency by the employment of barium platinocyanide, and the latter substance will probably be the one most employed in the future.

The use of the X-rays for diagnostic purposes is being developed to such an extent that we may safely look forward to the elimination of many difficulties which now baffle the physician as well as the surgeon. Fractures and dislocations have no more elements of uncertainty, foreign bodies are easily detected, some growths can be made out within the structures of the human body, effusions and exudations can be recognized by the skilled and trained eye, the process of necrosis of bone is clearly visible, osseous deformities and pathological deposits can be seen under favorable circumstances. Even the more opaque organs, such as heart, lungs, liver can be scrutinized. The X-rays are in their infancy, and a glorious prospect of their possibilities is opening before our eyes.

F. SCHAVOIR.

DISCUSSION.

Dr. G. B. MASSEY, of Philadelphia, Pa., suggested that the committee give attention next year to the matter of transillumination. He said that he had done some work in the direction of transillumination of the pelvis. He had devised a method of covering a small electric light of eight volt power with two test tubes sufficiently large to shield the light. These are slipped into another larger test tube. This gave three air spaces and three glass spaces to keep the light cool, and the whole apparatus was aseptic.

The great difficulty in practice was to make the light pierce the abdominal walls in all but those patients having thin abdominal parietes. The value of such a method of diagnosis would be limited to the discovery of necrotic or very dense fibroid conditions. For instance, it would probably detect dead blood in a hæmatoma, and it was quite probable that it would detect the difference between a cystic tumor of the ovary or tube and an ectopic pregnancy.

Dr. F. B. BISHOP, of Washington, D.C., said that in the *Scientific American*, a year ago last spring, there had been published a formula for making the tungstate of calcium. The directions were to fuse equal parts of tungstate of soda, chloride of calcium and chloride of sodium in a covered clay crucible in an ordinary fire. After the mixture had thoroughly fused (which would require about two hours), the crucible was to be taken out and allowed to cool. The directions were to break the crucible and remove the crystals, but by doing this he had obtained a mixture of crystals and dirt. He had then tried another method. After having thoroughly cleansed the crucible, he allowed the mixture to dissolve slowly in cold water. The crystals would then sink to the bottom. After all the soluble salts had been dissolved out, he obtained clean white crystals. These were spread evenly on the screen by means of white shellac dissolved in alcohol.

Dr. R. J. NUNN, of Savannah, Ga., asked if the substance thus obtained was also phosphorescent. He explained that some salts —as, for instance, the ordinary tungstate of calcium—were both phosphorescent and fluorescent; in other words, there would be an image left for a time after removing the object. In a recently made fluoroscope there was no phosphorescence whatever, the image disappearing immediately on removal of the object which had produced the image.

Dr. BISHOP said that with his fluoroscope the image disappeared as soon as the object was removed.

Dr. R. NEWMAN, of New York, asked Dr. Massey if he had made any investigations with the X-rays with a view to ascertaining the position, adhesions and pedicles of tumors, particularly of fibroid tumors of the pelvis and uterus.

Dr. MASSEY replied that he had not done this so far, because

of his lack of a practical knowledge of photography. He could appreciate the very great value of the line of investigation suggested by Dr. Newman.

The speaker said that he had an X-ray photograph of the trunk of a thin man, made by a physicist in the University of Pennsylvania, in which the two outlines of the heart were very distinct, one apparently representing the systole and the other the diastole. These were the only distinct non-bony outlines. Satisfactory work in this line, he believed, necessitated the use of several superimposed photographs.

Dr. C. R. DICKSON, of Toronto, Canada, referred to some experiments made at his office on his own person. Dr. Charles O'Reilly and Dr. Peters, of Toronto, had stated that they had been able to detect the diastole and systole of his heart. The tube had been excited by means of a static machine. He had been anxious to hear of successful work of this kind on pelvic tumors, and while many experiments in this direction had been carried out in his city, no one so far had reported successful results in examining fibroids.

The President remarked that he believed that good pictures had been taken of tumors which were full of fluid, or entirely empty; indeed, he had seen such pictures.

Dr. MASSEY said he understood that pictures of the stomach had been taken in which the organ had been dilated by drinking lime-water, and that this gave a dark shadow.

Dr. NUNN confirmed this statement, having had an opportunity of seeing such a photograph.

Dr. DICKSON referred to a case of dislocation of the hip which had nearly led to a suit for malpractice. Several skiagraphs had been taken by different operators, without a result satisfactory to the patient. The patient had then insisted upon a longer sitting, which was given. As a result of this, the skin and subcutaneous tissue began to break down quite rapidly in the course of a few days, and finally resulted in an enormous ulcer on the abdomen and groin. The slough below Poupart's ligament was at least three-fourths of an inch deep, and several large blood-vessels were exposed on its surface. This was the most extensive ulceration that had been reported as following exposure to the X-rays.

Electric Treatment in Gout and the Uric Acid Diathesis.

By Robert Newman, M.D., New York, N.Y.

From careful observations and experience the author asserts that gout and kindred diseases can always be checked, relapses prevented, and many cases cured by the judicious application of electricity, particularly with the static current.

To this Association three papers have been contributed, bearing on the subject under consideration. The first was read in 1891 at the first annual meeting by Dr. W. F. Robinson, on "Electricity in the Treatment of Rheumatism." He recommended the galvanic current in affections of one or two joints; and static electricity if the rheumatism is generally diffused in the body, in which case he gives the static sparks. Applications may be made on alternate days, lasting ten minutes.

At the same meeting Dr. Margaret A. Cleaves read a paper on "The Use of the Galvanic Current in Articular Inflammatory Exudations." The treatment was by the galvanic current, constant or interrupted; in one case after thirteen seances, it was followed by faradization. The point taken is the use of electricity during an acute stage, instead of waiting for the chronic state. The argument is, that electricity can be used in an acute stage, that there is no danger to develop *more* acute inflammation. In waiting for the advanced stage, the case is more difficult to handle, meeting thickenings of the articular tissues, contractions of limbs, exudations, impairment of movement, even anchylosis. Such teachings are more modern, very rational and deserve much consideration in the use of electro-therapeutics.

At the sixth annual meeting at Boston in 1896, Dr. J. Griffith Davis contributed a very practical essay, "Uric Acid: The Role of Electricity in its Treatment." Advanced grave cases with complications were cured with the faradic current, but from later observations the good results of the static sparks were acknowledged. Dr. Rockwell * says that the galvanic current in the treatment of

* Rockwell—E.p. 33 in "International System Electro-Therap."

gout and rheumatism should be selected on theoretical grounds, but from his own experience he is in favor of faradization, and the higher the tension the greater appears to be its analgesic properties. For this reason, the static induction current, the tension of which is enormous, is often serviceable.

Cataphoresis can be used to introduce therapeutic substances into the system by electricity, in which case it is difficult to say whether the medicine or the electricity gives a benefit. Edison * has made experiments with cataphoresis in gouty concretions as follows: Galvanic current of twenty milli-amperes was passed through a jar containing an aqueous 5 per cent. solution of lithium chloride in which the patient immersed his hand up to the wrist. The other hand was similarly immersed in a solution of common salt. The current was given four hours a day for six consecutive days. The size of one of the joints was diminished and pain relieved.

The writer has tried this treatment, but found it too heroic, painful, troublesome, using too much time, with results not in proportion to the process. Besides patients, as a rule, will not submit to four hours' daily treatment.

As a rule galvanism has been recommended in these diseases by former authors. Professor Senator † (Berlin) suggests the descending galvanic current in rheumatism, Remak ‡ uses strong galvanism. The papers mentioned are rational, written with an honest purpose, with close observation of results, and must be accepted as reliable. There is no contradiction, if different currents of electricity have been used and reported successful. There is only one electricity, which is always mingled with some magnetic power; but there are different currents, instruments and ways to apply it as an electro-therapeutic measure, which to choose, in the particular case, is the art of the physician. Each author mentioned has good reason for applying the current indicated according to the disease, its stage, symptoms, indications and complications and the patient himself. The writer would select the galvanic current in cases as mentioned by Dr. Cleaves and others. The static and

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* *N. Y. Medical Record*, November 15, 1890—p. 549.

† Ziemssen, "Pathol. and Therap." Vol. 13.

‡ Remak, "Galvano-Therapie," Berlin, 1858, p. 413.

faradic currents belong to the same class, only that one has a higher tension, and such should be selected in appropriate cases. The writer is familiar with the wonderful power of faradization in absorption of fluid in anasarca, as Dr. Davis has used it. The reason for selecting a particular method or current will be given later, after a general consideration about uric acid,

Uric Acid.

The literature on uric acid in disease is too abundant, and theories and practice of different writers vary greatly, so that it gives rise to mooted questions, and therefore arise doubts about the present status of these diseases and their treatment. In many ways acknowledged authorities make just opposite statements. The writer knows his shortcomings and inability to settle such questions, and will not attempt to make positive statements. He also finds that his experiments and tables thereof are not of any practical value. Hence, I offer only observations and references which will show the diversity of views.

Excretion of Uric Acid.

According to Professor Wormley the normal standard of excretion of uric acid is eleven grains daily. In contradiction, our modern physiologists state that uric acid seldom, if ever, exists in a free state in normal urine.* In normal urine uric acid is combined with soda, ammonia, potassa, lime and magnesia. Therefore, the presence of uric acid in the urine manifests a constitutional disease, in which one or several organs are involved, as the liver, assimilation in general, stomach and bowels in particular, the blood, kidneys, ureter, bladder, urethra, etc. As a rule, we are told that the retention of uric acid in the system is the cause of disease; while others may state that the uric acid is a consequence of the disease.

The quantity of uric acid in the system cannot be known, because if urine contains a large percentage of uric acid, it does not indicate the quantity of excess in the system, nor does a clear

* Flint's "Physiology," p. 416.

urine, with little or no uric acid, prove the absence of uric acid in the system.

Reaction of urine with uric acid is generally considered acid, and as a consequence of faulty diet; but it has been also observed, that during an abundance of uric acid excretion, the reaction is decidedly alkaline. One observer found uric diathesis from drinking alkaline water.*

The cause of uric acid and gout is generally traced to overfeeding and a consequent plethora, which, however, does not explain the extreme anæmia and weakness observed in many cases.

The presence of uric acid is found in many diseases, of which the following may be mentioned: Angina, bronchitis, catarrh, mitral stenosis of heart, dyspepsia, diseases of the liver and bowels, nephritis, anasarca, headaches and hyperemia of brain, lead poisoning, genito-urinary inflammations,† neurasthenia,‡ rheumatism, gout, atheroma in arterioles.§

The following are some of the conclusions of Dr. Pearce's paper: "Disturbed metabolism is the cause *sui generis* of a number of symptoms in many constitutional diseases.

"That finding, as we have, such variations in the quantitative findings of uric acid in the same case under apparently similar symptomatology, and with much variation in diet, exercise, etc., we must assume that the cause is not dietary indiscretions nor idiosyncrasy in many cases.

"That certain persistent occipital headaches, not relieved by proper glasses or eye-treatment, may be due to uric acid deposited in the meninges."

At the last meeting of the American Medical Association, in June, 1897, at Philadelphia, in "Discussions on Gout," some remarks of Dr. H. C. Wood deserve mention. "He wished it clearly understood in the first place that all our scientific knowledge of gout at present amounted to little more than a mass of

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* Dr. W. W. Reed, Fowler, Col., *Journal American Medical Association*, August 28th, 1897.

† "The Relation of Uric Acid Excess to Genito-Urinary Inflammations," by Bransford Lewis, M.D., *Journ. Cutan. & Gen.-Urin. Dis.*, July, 1897.

‡ "The Role of Uric Acid in Neurasthenia," by F. Savary Pearce, M.D., *Virg. Med. Semi-Monthly*, June 25th, 1897.

§ Dr. N. S. Davis, jun., Meeting Amer. Med. Assoc., June 4th, 1897.

trundling expectation, upon which hereafter was to be built some true knowledge."

The field of uric acid in disease is so wide, and our knowledge about it so indefinite, that it prompts the writer to abandon the large field and confine himself to gout and its electric treatment, with good reasons for the selection of the proper current.

Gout may be acquired or inherited; acute or chronic. Of the latter, gout as an inherited disease will be particularly considered in this paper.

The Theory of Gout.

There are different theories about the cause and progress of gout and its treatment. The following appears worthy of note:

Gout is a constitutional disease. During painful attacks there is a retention of uric acid and its salts in the system and in the blood. Diathesis present, faulty digestion causes an attack. The manner of the production of uric acid is not sufficiently known. The spleen is probably a factor in its production.* Theory of Garrod† that the kidneys are diseased. An acute relapse of gout is caused by the irritation in the tissues pregnant with retained uric acid.

Prognosis in chronic gout is, that generally it ends with death, either after long sufferings through complications, or suddenly as apoplexy or angina pectoris. Prof. Senator says that treatment effects amelioration and cessation of attacks but no permanent cure. Relapses appear *a locus minoris resistentiæ.*

Treatment consists in medicines, diet, exercise, mineral water and electricity.

1. Medicines have been recommended in great variety and combinations; some benefit typical cases and may not help others; sometimes all are unsatisfactory, and one remedy which always has cured one patient may suddenly prove useless for the same individual. Ebstein says alkaline remedies are to be used, not abused. In some cases, however, alkalines aggravate and acids may benefit. Therapeutics of all kinds and forms have been used, but to enumerate them here would be useless.

* H. Ranke, "Beobachthungen üeber Harnsäure," München, 1858.

† "The Nature and Treatment of Gout and Rheumatic Gout," by Alfred Baring Garrod, F.R.S., M.D., London, 1859.

2. Diet ought to be good, but the statements of authorities are very contradictory. Some order a vegetable diet or milk and no meat; others say meat only. Dr. Senator recommends a mixed diet, with avoidance of fat. One patient did not improve on vegetables, was told to eat less of vegetables, more of meat, and improved at once. Almost all physicians prohibited coffee, tea and alcoholic liquors, which appears to be rational, but in practice we find that patients need whiskey as a diuretic, and grow worse and weak if the whiskey is omitted. My friend, Dr. A. T. E., says he has attacks of gout and cures himself by drinking champagne, while other patients provoke an attack by champagne. Dr. Armstrong* in *British American Journal*, May 1, 1897, states that he gives only red meat and hot water.

3. Exercise, active and passive, is, perhaps, one of the best remedial agents, because it regulates the circulation, stirs up the action of the different organs to a normal state, and thereby eliminates the effete material from the body. Bicycle riding is undoubtedly a good way to exercise.

4. Mineral waters, drunk at the spring, have done good for various reasons, of which one is the execution of all strict orders from the physician at the spring. Carlsbad is the principal place where patients are sent. However, many sufferers get well from electric treatment without ever being at Carlsbad. The writer knows also some cases which were benefited by drinking imported Teplitz water, which is pleasant to the taste and acts on the mucous lining, particularly on the kidneys, as a valuable diuretic.

5. Electricity, sometimes in combination, but often without the aid of any other remedy, has positively cured rheumatism and gout.

Different instruments and currents may be used with success, as indicated in the papers mentioned before. In some cases it will do well to change the mode of application. Gout may be acute and acquired or hereditary. In the first form a positive cure can be promised in almost every case. The chronic form is more difficult to cure, and the treatment must be continued over a longer period, and new attacks guarded against by the early application of electricity. If some cases of chronic gout are not cured, at least

*"The Value of an exclusively Meat Diet in Chronic Gout," *Journal American Medical Association*, August 14, 1897.

the single attacks are, and relapses can be prevented by attention and proper treatment in time when the system manifests any abnormality. This rule has particular reference to the treatment of hereditary gout with the static current, and to give evidence of this is the particular purpose of this paper.

Static Electricity.

First, it must be shown what qualities the static current possesses which make it desirable to choose it in these affections, and what effect it may have in mastering and correcting the irregularities in the system.

Static applications have the same properties which are attributed to general electricity; it has a high potential, high frequency current. The physiological effects of high frequency, high potential currents, are so well described by our member, Dr. W. J. Morton, who is the pioneer of the static electricity and has been so often quoted that the writer can well omit repeating and referring to his writings.

We use the static electricity in different ways, as massage, as an induced current, in which shape it takes the place of faradization, but generally as a spark or breeze in different varieties. As a rule, the patient is placed on an insulated platform with which the positive pole of the machine is connected. The electricity is thereby concentrated in the platform, and the patient becomes the end of the positive electrode in which the electricity accumulates. The other electrode connected with the negative pole is managed by the operator and brought near the patient's body. Sparks, breezes, as the case may be, are given or, more correctly, taken from the patient. For any particular reason the poles may be reversed, if the operator sees any indication.

The curative power of the static application has been tried fully, as follows:

1. Static electricity is generally diffused in the body, and penetrates deep through tissues and joints.

2. It acts as a general tonic.

3. The breeze allays any pain in most instances in five minutes. In very painful affections of the joints it needs several applications before the pain and infiltration is removed, but when an attack is

in progress, in three applications in a single day freedom of motion and cessation of pain should be expected.

4. Headaches and confusion of the brain and the uneasiness of the mental forces are removed by the breeze.

5. It equalizes the temperature and restores it to a normal degree, no matter if the temperature has fallen or been raised through the disease.

(Dr. Cleaves has made valuable observations on this point.)

6. The circulation is equalized. One distressing symptom in gout is the feet being so cold, like ice, a feeling as if they do not belong to one's body—numb, so that locomotion is almost impossible. The sparks will equalize the blood circulation, and thereby remove that distressing symptom.

7. The animal heat is favored, the action of the skin restored, and even diaphoresis evoked.

8. It stimulates the organs to a better secretion. The liver, bowels, kidney, etc., which were sluggish, or were interrupted in their actions, will resume their functions.

9. It favors the excretions of effete material, purifying the system of uric acid, etc.

10. Removes nervous debility.

11. There is an absorption of inflammatory products, in joints, as well as fluids, as we find in anasarca.

12. It substitutes exercise, and acts as passive motion.

These effects are so well established, and have been observed by different authors, as well as by the writer on himself and on other patients.

Analysis for Uric Acid, after electric or other treatment. By the kindness of Mr. Merck, analysis was made in Merck's analytical laboratory by his chemist, Mr. Murray, of the urine of a patient having hereditary gout, in order to ascertain the excretion of uric acid at different periods. One pint of the quantity voided during the last twenty-four hours was submitted for analysis in each instance. The result was as follows :

Specimen I.—Without Treatment.

September 9th, 1897.—Two weeks after a slight gout attack. During these two weeks patient had not had any treatment.

After a hot day, 46 ounces were passed in 24 hours, of which one pint was submitted for analysis, with the following result: "Total quantity for 24 hours, 1,305 c.c. = 46 ounces. Color, pale, cloudy. Odor, uriniferous. Reaction, strongly alkaline (ammoniacal). Spec. gr., 1020 at 15° C. Deposit, quantity and general appearance, abundant, light, flocculent. Phosphates present. Albumen present. Uric acid, 0.334 gram = 5 grains for 24 hours. Microscopical examination, crystals, triple and amorphous phosphates."

Specimen II.—After Three Days' Electric Treatment.

An attack of gout beginning; liver sluggish; tongue thick, white furred. Left foot very œdematous and painful, impossible to wear a boot; general uneasiness. Static sparks were given for three days every day for ten minutes, which treatment prevented a serious sickness, and cured. Treatment was given on September 12th, 13th and 14th. No medicine, no particular diet. September 15th, 1 pint for analysis of 59 ounces of urine passed in 24 hours. Report received as follows, No. 143:

"The Merck Analytic Laboratories,

"*New York, September 17th, 1897.*

"Physical and Chemical Character.—Total quantity for 24 hours, 1,745 c.c. = 59 ounces. Color, pale. Odor, strong. Reaction, acid. Spec. gr., 1020 at 15° C. Deposit, quantity and general appearance, small phosphatic. Phosphates present. Albumen present, after persistent and careful tests. Uric acid, 0.1360 gram = 2.09 grains for 24 hours. Microscopical examinations, nothing particular pathological."

On comparison of the two specimens, we find that after the treatment by the static electricity for only three days, and during a gouty attack, the patient was cured, the attack abated, the urine became acid, phosphatic deposits and albumen were less, and the excretion of uric acid was very much reduced. The first specimen, taken while the patient was apparently well, without any electric treatment, showed more pathological changes of a grave character, of which the larger amount of uric acid is the

most important point, which, to recapitulate, was, without treatment, excretion of uric acid, 0.334 gram for 24 hours. After three days' electric treatment, the excretion was 0.1360 gram for 24 hours.

Hereditary Gout.

While it is admitted that gout is a diathetic disease, such diathesis may be entirely congenital and inherited, in which case the afflicted are not able to acquire or prevent the disease. The statistics of Scudamore prove the statement, as in his observations of 523 cases of gout he traced 309 to inheritance, the disease having existed in one or two of previous generations. Even Garrod states fifty per cent. as hereditary. The writer has authentic assurance of inheritance, and will state only one family history, and from his own observation. The disease ran through three generations, in two continents, and the observations begin with the grandmother, who died in 1836 in Germany.

She had been married twice, had four daughters, two by each husband. All four daughters married, all had gout and died from complications; one of apoplexy in 1838, one of angina in 1840, and the last has had severe attacks and died of anasarca in 1875, at the age of sixty-nine. Some of the male cousins of the old lady suffered also with gout. The children of the daughters of the third generation all suffered with gout. One widower married again and his second wife had three children, which are well and still alive; while the three children of the first wife, the gouty, all died in consequence of complications of gout, the last son in 1888. Two children of the daughter who died in 1875 went to America, had severe attacks of gout, and the daughter, a widow, died with meningitis in 1888; while her brother had succumbed to heart failure in 1886, both complications of gout and during attacks. The children of the other two daughters were reported dead, except two males, who in 1890 had a miserable existence in Germany, had gouty spells with deformities of the joints. The sufferers in this family were mostly females, none of which have been reported as high livers, none drank liquors or beer, of some the writer knows positively that they never drank, and others may have drank a glass of wine on particular occasions like birthdays.

This history has been mentioned to show, (1) that the gout was inherited; that (2) it could not have been caused from faults in diet or drinking liquors; and (3) that it occurred mostly in females, against the reported statistics which show a very small percentage of females having gout.

The clinical history of chronic gout has been often and well described by many authors. Hence only some symptoms will be mentioned here for the purpose of showing the indications for making static applications. After the patient has had such experience for years, he may expect a new attack and watch for the same. It generally begins with some dyspeptic symptoms, the appetite is failing, the liver is sluggish, bowels constipated, some gases in the bowels annoy, there is headache, general depression, failing of mental brightness, no inclination to move about, a slight rise of temperature, a beginning of stiffness in joints, a pain and swelling of metatarso-phalangeal joint of the great toe, insomnia, general restlessness, pruritus, cloudy urine with excess of uric acid. If only some of these symptoms are observed, static electricity is indicated, as sparks; and in most cases this treatment is so successful that amelioration is produced at once, and after several applications the patient is cured of that attack and restored to health. Medicine is not necessary. If the right time has passed over, the symptoms progress with severe pain in one or more joints, œdema, so that walking is impossible, the static applications must be made and oftener repeated, about three times a day to the swollen joints, the breeze applied or an electrode used as massage. Breeze to the head is very beneficial and agreeable. If neglected, the next step in the progress of the disease is increased pain, more joints affected, the veins enlarged, more uric acid is retained in the system, and nephritic colic ensues. Cystitis or even urethritis and immobility are increased, there are delirium, excruciating pains, etc. These complications may cause death.

If the static electricity is applied at the right time with care and attention, every attack can be allayed and even prevented, so that the patient is kept comfortable and in apparent good health. This electricity will do the work without any other measures, but adjuvants are not contra-indicated and may be used. In all cases under his observation the writer has succeeded perfectly as stated. As an illustration he will report now phases of his own case.

Case of Hereditary Gout.

Medicine failed, static electricity succeeded. R. N. has inherited gout from his grandmother. Has had attacks for 20 years, which became in time more severe and frequent. Has had the usual symptoms, excruciating pains, with all the sufferings described in text-books. Often could not move about at all, and if a little better, locomoted in agonies on crutches. Some attacks were aggravated with colic, during which kind friends watched for an opportunity to perform laparotomy for suspected appendicitis. Medicines allayed pain sometimes, at others the same remedies, as well as different, failed. The climax came in September, 1892, when it seemed that, in addition, acute articular rheumatism complicated the case so much that the pain was constant and excruciating in the joints affected, that any motion or a turning in bed was an absolute impossibility. The case was then treated by a physician of the highest standing and reputation, a professor in the largest college of New York, a man of ample means, a gentleman in every sense of the word, whose attention—a work of love—could not be exceeded by anyone, and whose kindness never will be forgotten. The treatment consisted in medicine, pushed for many weeks; gave no relief or benefit. The prognosis was bad, and ended in the advice, that if ever well, it was impossible to exist without spending four to six weeks every year in Carlsbad. Patient could not take more medicine, grew very weak, in which state he has been seen by several members of this association, who never expected to see him alive again; in fact, he was once declared already dead. At a critical moment Dr. Nunn and our lamented member Dr. Hutchinson suggested whiskey and beef juice to sustain life, which was carried out with marked benefit. Improvement followed through time and sustaining measures, but the patient remained in a low state, crippled and obliged to move most of the time on crutches. In the beginning of 1893 friends recommended static electricity, and the first applications were given kindly by Dr. Margaret A. Cleaves three times a week, so that in due time patient could walk well without any support, without pain. In the spring he met in a car his former medical attendant, who was surprised to see him looking so well, and would not

believe that static electricity, without any medicine, had made the improvement. The static applications have been continued at home whenever required. Sometimes on purpose treatment was delayed until a new attack had been so far advanced that the joint of the great toe was swollen, and the pain increased to such a degree that, on rising in the morning, it was impossible to use the limb for walking, and locomotion had to be made with a crutch downstairs to the office, where static electricity was applied. The first seance ameliorated the bad symptoms, the second application made the state comfortable, and the third, all on the same day, cured the attack. No extra diet was enforced—whiskey moderately used acted as a diuretic and benefited much. Sometimes alkalies were added, which never benefited, and sometimes even increased the excretion of uric acid and the general irritability. Through the electric treatment the patient has been kept well, so as to enjoy life without any serious sickness for nearly five years. The hereditary gout is not eradicated, but all attacks have been warded off by the timely use of the static machine. The treatment consisted in sparks and breezes as indicated.

Conclusions.

1. There are a variety of causes and symptoms of gout.

2. The diet and treatment, etc., cannot be stated as a routine for all cases alike.

3. It is wrong to treat the disease ; the patient must be treated as an individual, according to indications.

4. There are some points in gout and the uric acid diathesis which are not understood at present.

5. Hereditary gout exists, and will manifest itself in individuals without their own fault.

6. Hereditary gout as a diathesis cannot be eradicated by any treatment, nor is it the consequence of overfeeding or the use of fermented liquors, for the reason that it has been observed in females who dieted and never drank liquors or beer.

7. Static electricity is the best treatment in hereditary gout, and will prevent attacks if used judiciously at the right time, and thereby keep the patient comfortable and apparently well.

8. Static electricity and other electric currents will cure many of the other varieties of rheumatism and gout.

DISCUSSION.

Dr. MARGARET A. CLEAVES, of New York, said that she recalled very distinctly the time when the reader of the paper had himself been suffering from gout, and had expressed his disbelief in the efficacy of static electricity in such cases, and particularly in his, as it was hereditary. She had herself seen other cases successfully treated by general franklinization. It had been recently stated by a physician that the bicycle should be looked upon as the best antiuric agent we possessed, yet much as she believed in the bicycle she was inclined to believe that it would be better to regard electricity, and particularly franklinization, as the best antiuric agent at our command. Our object should be to put the patient in a good nutritional state, further all the processes of oxidation, and secure a normal proportion between the urea and the uric acid. The result would be a relief of the symptoms from which the patient suffered.

Dr. G. B. MASSEY, of Philadelphia, Pa., said that in spite of our knowledge of medicine, when one got sick one was always eager to hear of any means which offered possible relief from the ailment. Personally, his growth of faith in the efficacy of static electricity in metabolic diseases had been slow, for at first he had been a strong believer in the chemical action of currents in most organic conditions. He was now a decided convert to the belief in the value of static electricity in these metabolic conditions. He had seen too often the good effects of a single application on sluggish metabolism, as shown by increased color of the skin and increased perspiration, and followed by a tendency to resumption of perspiration in neurasthenic conditions where formerly perspiration had been absent or very scanty.

The subject of the uric acid diathesis is a very broad and abstruse one, and doubtless would not be cleared up until our chemical knowledge had been extended. It was true that the treatment was rather of the patient than of the condition, yet there were certain underlying principles to be borne in mind. It was quite unlikely that the underlying condition of gout was microbic, and, to his mind, the condition called lithæmia was really one resulting from the failure of the nervous organization governing

excretion. As he had stated in a paper before the Section of Neurology of the American Medical Association, he believed the profession had almost forgotten that there was such a system of nerves as the sympathetic. Such a statement had also been made by him before the Philadelphia County Medical Society, and a neurologist there had practically denied that there was such a system in existence as the sympathetic! Personally, he believed that static electricity did in some way have control over this sympathetic system. He was also convinced that, by combining the galvanic and faradic currents, much good could be accomplished. These currents should be sufficiently strong to reach the centric ganglia; probably at times as much as 150 milli-amperes of current would be required. Our object should be to stimulate the neurons of the central nervous system. It was well known that the action of electricity is to stimulate all cell life. In a number of cases he had clearly proven that this method, alternated with static electricity, would markedly improve the general condition, and especially stimulate the metabolic activities so necessary for the maintenance of normal nutrition.

Dr. R. J. NUNN, of Savannah, Ga., said that the paper was extremely valuable, particularly as it contained the results of personal experience. We should not forget that our views of medical action were constantly undergoing change. Those changes which we were fighting for to-day might be regarded as absolutely false to-morrow. The chemical theory was not quite gone yet; some could remember the old humidic theory, and now we were talking about the microbic theory. We were now approaching a different phase of medical philosophy; we were getting nearer the vital force. By this he meant we were beginning to recognize this force more. Not many years ago some of the members had been inclined to scoff even at the *vis medicatrix naturæ*. We must treat the patient, not the microbe. What did this mean? It meant simply that the highest potential of electricity which we could handle was to be brought to bear upon the patient. We think we know that this vital principle is a high vibrational state of the ether, and that this state approaches more nearly to franklinism than to anything else at our command. The only trouble about the application of this to general practice was the

great difficulty of managing the static machines far away from medical centres. The denial of the fact of the existence of the sympathetic system was really so wonderful as to excite comment. It seemed to him that its existence had been so many times demonstrated that it was marvellous that anyone should deny its existence. The whole nervous system was after all a series of brains, although one brain in the human body does most of the work. In the old experiment with the headless frog, the animal would seem to be dead if there were no sympathetic system, yet the frog without a head or spinal cord is able to respond to a stimulus, such as the application of acetic acid. Try the same experiment with the alligator, without having taken the precaution to get out of the way of his tail, and the experimenter would certainly become convinced that there is such a thing as the sympathetic system. The paper and discussion this morning showed the changes of opinion that were taking place.

Chorea.

By Francis B. Bishop, M.D., Washington, D.C.

This subject, while very old and perhaps a little threadbare, is one that offers a wide field for speculation, and the object of placing it before this body is that it may be thoroughly discussed, particularly as to its etiology, pathology and treatment. This paper is not intended to embrace cases of organic origin, but the greater number of cases which in the present light of pathology are necessarily classified as functional, and at present must be treated as functional diseases.

It seems to be the opinion of the most advanced pathologists that this disease is the direct result of some infection—in other words, that it is a germ disease; while others hold that the rheumatic diathesis particularly predisposes to it. This may or may not be so, and the question of a positive etiology and pathology seems yet to be in doubt.

It is reasonable to believe, however, that an unstable condition of the higher nerve centres predisposes to this condition, and that any poison affecting these centres may produce in one person epilepsy, in another a general neurasthenia, and in another chorea. It is not an unreasonable hypothesis, in the light of personal experience, in my section of the country at least, that rheumatism plays very little, if any, greater role in the disturbance of these centres than does malaria, scarlet fever, measles, whooping-cough, influenza, or any of the contagious or infectious diseases. Indeed, in some of the southern and middle States the facts would seem to bear out the impression that malaria is largely responsible not only for the chorea, but also for the rheumatism that is often looked upon as the cause of the chorea which may accompany or follow the rheumatism or malaria. Whether this hypothesis is correct or not, there is no doubt of the fact that there is an unstable condition of the nerve centres; and what concerns us as electrotherapeutists is, what role does electricity play in the cure of this malady, aided, of course, by such remedies as may appeal to our judgment as the proper thing to use in each particular case.

A severe nervous shock, such as fright or grief, is often all that is necessary to disturb the equilibrium of the nerve centres in these predisposed subjects. Anæmia is laid down as a predisposing cause of chorea; but my observation has led me to the conclusion that the anæmia is often the result of the chorea, or the direct result of the irritant, acting upon the higher nerve centres. The chorea may precede or follow the anæmia, or they may appear simultaneously; and here it is interesting, in this connection, to note a few points on anæmia from Landois' and Sterling's "Physiology." They say that "in *acute fevers*, as the temperature increases, the number of *red* blood corpuscles *diminishes*, while the *white* corpuscles *increase* in number." Again: "By greatly cooling peripheral parts of the body, as by keeping the hands in iced water, in some individuals possessing red corpuscles of low resisting power, these corpuscles are dissolved, the blood plasma is reddened, and even hæmoglobinuria may occur." Again: "Abnormal forms of the red corpuscles have been observed after severe burns; the corpuscles are much smaller, and under the influence of the heat particles seem to be detached from them. *Disintegration of the corpuscles* into fine droplets has been observed in various diseases, as in severe malarial fevers."

From this it appears that any severe shock to the nervous system, whether it be rheumatic fever, malarial fever, or any other acute fever, excessive cold to the periphery, or a severe burn, may have a deleterious effect upon the red corpuscles of low resisting power, thereby predisposing to anæmia. The same causes seem to operate upon the cortical motor centres of the brain when in an unstable condition, predisposing to chorea, neurasthenia, epilepsy, or some other so-called functional nervous disorder. Hence, in those cases we usually have anæmia accompanying, preceding or following the nervous manifestations. Therefore, even after the exciting causes have been removed, the anæmia, still existing, affords such poor nourishment to the disordered nerve centres that they are incapable of recuperation without assistance.

What concerns us as physicians is, How can we best render assistance to these poor unfortunate patients; for we well know that medicines often prove futile when depended upon entirely.

The menstrual period is a very trying time to the nervous girl,

and when normally performed lowers the number of red corpuscles ; and very frequently, when obstructed or suspended for any length of time, may give expression to intense symptoms in the form of chorea and anæmia, or one or more of many functional nervous troubles.

That electricity plays a most important part in the treatment of the latter class of cases can, I think, be no longer a question for doubt. The following case is that of a young girl of sixteen whom I have known from childhood, and treated for various ills peculiar to children. She has passed through most of the diseases of childhood, including an attack of diphtheria. She has always been pampered and petted and allowed to have pretty much her own way, and tight lacing was early practised. At the age of fifteen she was sent to a boarding-school. At that time she was accustomed to plenty of outdoor exercise. This was exchanged for close rooms and long hours of mental labor. The menstrual functions were performed irregularly ; nervous twitchings began, and became more and more prominent. She soon showed signs of mental deficiency, anæmia and chlorosis followed, and she was sent home a full and well-developed case of chorea. With the exception of measures to relieve constipation, this case was treated exclusively by electricity, rest and nourishing food. The electrical treatment consisted of twenty minutes in the ozone cage every day. In five or six weeks she was perfectly restored to health, her functions being performed normally, and all symptoms of chorea had disappeared. The mild galvanic current was passed through the head two or three times a week, in addition to the ozone treatment, the positive electrode over the motor area first on one side and then the other for one minute, the negative at the back of the neck. The current strength was not more than one or two milliamperes, turned on very carefully and always stopped as soon as the patient could detect the taste of the current, no matter how little the impression upon the needle of the meter. The quieting effects of these treatments were often visible at once, and were frequently followed by refreshing sleep.

Another interesting case in which the heavy static spark plays an important part, was one in which the sensory as well as the motor nerves were involved; and the muscles of the lower extremi-

ties were so weakened as to cause the patient to walk with a reeling gate, like one intoxicated. Indeed, she was once accosted by a fool of a policeman while on her way to my office. He claimed that he thought she was under the influence of liquor; she was at the time being assisted by her sister. I will give the history of the case in her own words, copied from a letter she wrote at my request:

"Having been very nervous from childhood, at the age of fifteen years, which was three years ago, I suffered a great shock, which preyed upon my mind so that it resulted in my being taken with severe pains in my limbs and arms, which were so painful that I could not bear a light cover to touch me, or anyone to speak, while suffering these pains. About a year after I began to stagger in my walk; my right foot would jerk away from me and bounce several times before touching the ground. While sitting my foot would move off, and I had no control of it. I would reel from side to side, and could not stand or walk alone without leaning heavily on someone's arm. My feet felt at the bottom as if they were tied to a bag of mush. My limb was very heavy and would feel as if asleep, and I could not feel a pin in it. My heart would beat to suffocation at the least noise, and my head would shake also. Last winter my right eye closed for over a month, then my left eye closed the same way.

"Since undergoing the electrical treatment I find that I am steadily improving. My limb don't walk away with me as it did, and I have relief from those pains which were almost unbearable."

Her condition when I saw her, about a year ago, was practically as follows:

A slender girl of medium height, with a fairly good color, but anæmic and somewhat emaciated. Could not stand with feet close together, with eyes open or closed. Could not walk without staggering, knee-jerk absent in both limbs. No ankle clonus. Pupil reflex normal to light and accommodation. Loss of sensation to pain in both lower extremities below knee; could not feel a pin stuck well through the skin. Choreic movements well marked in right leg, head and hands. Complains of severe pains at night with numbness all the time in limbs, and often pain around chest. This case had been treated with arsenic, potass-iodide, iron, quinine and a number of other remedies before coming for

electrical treatment. In fact, the diagnosis had been made of posterior spinal sclerosis, a mistake very easily made in this case.

While this case is not well yet, and I am not prepared to say how soon, if ever it will be, it certainly has steadily improved, and the young lady looks and acts as though she really intends to recover.

The treatment has been, since under my care, quinine (from twelve to fifteen grains a day) administered for a week at a time because she lived in a malarial neighborhood. At first it was necessary to administer opium at night for the relief of pain. She has been treated electrically not more than twice weekly, and very often not more than once a week, with galvanism to the head, the ozone bath and the heavy static spark, from a W. & B. six plate machine. The ptosis was treated with Faradism to the superior levator muscle. Rest was enjoined, with plenty of nourishing food. The fright she received from the policeman had a very bad effect, and for a while it seemed as though she would be as bad as ever, but she appears to be again steadily improving and apparently on the road to recovery.

My reason for treating these cases in the way indicated is based upon the hypothesis of an unstable condition of the motor, sensory, and very often psychic centres of the cortex, and that the perfect, harmonious and healthy action of these centres is distorted and inco-ordinate in consequence of some severe shock or some poison, and that they become so weakened thereby that they are often thoroughly incapable of themselves to throw off the spell that binds them, and that the gentle galvanic current passed through these centres stimulates them and aids them in their efforts to physiologic action. The static cage gently stimulates the periphery and is very soothing to the general nervous system; while the inhalation of the ozone permeates every tissue, supplying oxygen to the impoverished blood corpuscles, thereby giving new life to all the tissues of the body, including the nerve centres themselves. The static spark, of course, is not used unless there is considerable loss of sensation, and in that case there is nothing else that will restore it so quickly.

I hope, Mr. President, that this subject may be fully discussed, for I believe that in recognizing and successfully treating so-called functional disease lies our greatest field of usefulness.

DISCUSSION.

Dr. G. B. MASSEY, of Philadelphia, Pa., took exception to the statement that in the treatment of neuroses the greatest field would be found for the use of the treatment described. He would hardly call the last case one of chorea; it seemed to him rather one of hysteria, with choreic manifestations. From that point of view, however, the treatment was even more valuable. The value of electricity in chorea was very considerable, as such cases were nearly always run down, and the tonic effects of electricity were particularly happy. The subject was worthy of further study.

Dr. MARGARET A. CLEAVES, of New York, said that in all cases of chorea there was a condition of malnutrition affecting the nerve centres. It might be due to malarial poisoning in some cases. It did not always matter what form of electricity was used; the great object was the improvement of metabolism and nutrition. It mattered not whether the condition to be treated was chorea or rheumatism, we would improve our patients by electrical treatment simply by the beneficial effects which it produced upon the general nutrition. She had seen some good results from electricity in chorea; in others, not so good. In a young lady of sixteen with chorea, an excellent recovery had been secured under general galvanization. The improvement had begun before there had been added to the treatment the internal use of iron and arsenic. She had treated other cases with electricity without any medicines, and with equally good results. There could be no doubt about the therapeutic value of the ozone generated whenever an influence machine was put in motion. The ozone exercised a good effect upon the blood corpuscles and caused an increase in the hæmoglobin. In most choreic patients it was her custom to use the convective method, or spray. In the young lady referred to, towards the end of the treatment the spark had also been used.

Dr. R. J. NUNN, of Savannah, Ga., referred to the case of a young lady of eighteen or nineteen years, with a choreic affection of the head. She was apparently healthy otherwise, and was certainly well nourished. He treated her electrically only, and she recovered. He was a believer that nine-tenths of our diseases, except the mechanical ones, were neurotic, and that hence our treatment must be directed to the nerve centres. This was the

rational explanation of the many beneficial results obtained from electrical treatment. As has been stated already by Dr. Cleaves, our treatment was largely a matter of securing or maintaining the proper nutrition of the nerve cells.

Dr. Cleaves remarked that we might say, in other words, that the nerve cells—the brain and the other smaller brains—were simply storage batteries, which were charging and discharging.

Dr. Massey said that he did not wish to belittle the value of electricity in neuroses, but we should not think that this was the only field for electricity. The action of electricity upon the cells, as well as the mechanical and chemical effects, should all be considered.

Dr. Bishop, in closing the discussion, said that he had hoped the discussion would embrace a consideration of the action of these different diseased conditions on the nerve centres, more particularly in relation to the predisposition of the individual. He had for a long time questioned his diagnosis in the case referred to by Dr. Massey. At first, posterior spinal sclerosis had been the diagnosis, and the peculiar sensation under the feet, the severe pains in the limbs, the inability to walk with the eyes closed, and the difficulty of walking even when the eyes were open, all favored such a view; but the age and sex of the patient, the history of a sudden onset after strong nervous shock, and the gradual improvement were rather opposed to such a diagnosis. He had never seen a case of posterior spinal sclerosis so severe as this one recover sufficiently to walk alone, as this girl was now doing. He was not prepared to say that there was not some organic trouble, still he felt that the disorder was purely functional, and that the girl would eventually recover entirely. He did not mean to say that electricity was not an exceedingly useful agent, even in some very severe organic troubles, but we should bear in mind that a great many of these functional disorders were diagnosticated as organic, and, as a result, the important element of hope was taken away from the patient. He agreed with Dr. Massey that there was a good deal of hysteria about this particular case; indeed, hysteria was a very prominent part of most cases of chorea at this age. However, in the present case he did not believe that the hysteria was the prime factor. The convective discharge he had obtained by the use of a specially constructed "cage."

Sources of Atmospheric Electricity.

By R. J. NUNN, M.D., Savannah, Ga.

In presenting to the Association the following thoughts under the title of the "Sources of Atmospheric Electricity," I do not wish to be understood at the outset as intending to touch at all upon the characteristics of that elementary matter, the manifestation of the disturbance of which we designate by the name of electricity. My sole purpose is to present some thoughts on the methods by which these disturbances are brought about which manifest themselves in the shape of lightning, electric storms, and of electric phenomena of various kinds, and to direct attention to what it is believed is a new field for investigation.

Writers on these subjects are constantly in the habit of saying that a cloud is negative and the earth positive, or *vice versa*, and that the current falling from one to the other in the effort to establish an equilibrium is one cause of the phenomena that we call lightning. We are told again that two clouds may be of opposite polarity, and that the current passing from one cloud to the other is also an expression of the phenomena called lightning; but this is an expression that does not express. It simply states what are said to be facts, and leaves the cause of the disturbances, which are assumed to exist, quite unexplained.

In this paper it is my intention to make such efforts to arrive at a more remote cause of these disturbances as will at least serve to bring the matter to the attention of the Association, and elicit from the members some useful discussion upon the subject.

In conformity with the usually accepted theory, it is assumed that all space is filled with ether, and it is further assumed that certain disturbances, or disturbances of a certain kind, will result in the production of the phenomena which we designate as electrical. The question now to be determined is, How are these disturbances produced?

It must be observed that in discussing this question no attention is given to that form of electricity which is generated by disturbances of the ether at these infinitely small distances which are within the

pervue of what is called chemical affinity ; nor is any account taken of the magneto-electric mechanical arrangements which have been constructed for the same purpose. Either of these forms of electricity is subject to certain limitations to which atmospheric electricity is not obedient. This may result simply from the difference of potentiality, or it may be an innate difference in the current itself, for it is evident that there may be as many unknown differences in electrical currents as there are in light, of which we have an example in the newly discovered X-ray.

Electric storms of inconceivable magnitude no doubt come to us from the vastness of the abyss of infinite space. In this idea there is nothing extraordinary, seeing that we receive our light from the same source. That the sun happens to be the medium through which light is transmitted does not in the least change the fact.

The experiments which are being constantly conducted all over the world, either for the purpose of scientific investigation or as commercial enterprises, demonstrate beyond peradventure that every trifling mechanical disturbance in the ether gives rise to electrical currents. It has also been satisfactorily shown that the presence of air acts rather as a resistant than as a medium of conduction.

In common with all space our planet is permeated with the ether, and the conditions for the production of electrical phenomena are the same here as elsewhere, taking into account the disturbing element of physical surroundings. It is safe to assume, therefore, that the same conditions which result in electrical phenomena here would produce exactly the same effects anywhere in the ocean of ether.

Like innumerable others, our solar system is a vast static induction machine, and is revolving through space at the rate of 150,000,000 of miles or more a year, towards the star Alpha Lyra. As we are accustomed to estimate velocities by the minute, this velocity may be better appreciated by saying that the estimates vary between five to ten miles a second, or 300 to 600 miles a minute. With the experience gained by experiments here it may be easily surmised that even in the ether itself tremendous electrical changes will probably take place when immense masses of

ether rush through space at such high velocities, which might prove to be slow were the velocities of greater systems known, but even if this were denied it would not materially affect the resultants which are supposed to follow, although perhaps the whole theory might not be symmetrical.

The fundamental idea of this theory is based upon the facts that worlds are everywhere turning upon their axes, these worlds revolving around centres in systems, these systems revolving around one another *ad infinitum*, and the whole changing its place at an immense velocity, ever rushing round through boundless space.

This conception forces upon us the idea that electrical disturbances have their initiation in the immense beyond, and are conveyed to the interior portion of the system. As an evidence that there is nothing far-fetched in this idea, the synchronism that exists between sun spots and terrestrial magnetic disturbances may be brought forward.

Only two motions will enter into this calculation, that is to say, the orbital motion of the earth around the sun and the diurnal motion of the earth on its axis.

It is impossible to conceive of a stream of fluid rushing into an ocean of the same fluid, even if it be ether rushing through ether, without a resulting displacement of particles ; in other words, without the production of a difference of stress or potentiality which means in ordinary parlance the production of electricity, and this action must always be in proportion to the volume of the moving fluid and its velocity.

The earth travels on its orbital path at the rate of 1,140 miles a minute, or 580,000,000 of miles a year, making at the same time its diurnal revolution at the rate of seventeen miles a minute, and this discussion will be confined to these two motions, because, the others would be too obscure to be taken into consideration, and would unnecessarily complicate the discussion.

The earth, then, accompanied by its atmosphere, is rushing on its orbital path at the rate of 1,140 miles a minute. It is evident that as the atmosphere is retained in contact with the earth's surface by the attraction of gravitation, the force of attraction gradually lessening as the distance from the earth increases, the

atmosphere in immediate contact with, or close to the surface of, the earth will revolve with it on its axis, while the tendency of that at a distance from the earth's attraction will be to cease revolving and accumulate behind the earth. It must now be evident that electrical disturbances must have been produced by the onward rush of the earth and the displacement of its atmosphere, and there must be a difference of tension between that portion of the atmosphere which has accumulated behind and that which, being in front, is of necessity exposed to the greatest amount of friction.

As there is a difference in the attraction exercised by the earth in proportion to the distance from its surface, it is evident that at some point the atmospheric inertia must neutralize the earth's attraction, and wherever this occurs there must be friction between that portion of the atmosphere which is carried round by the earth in its diurnal revolution and that which is outside. This friction must of necessity give rise to electrical phenomena.

It will be seen that there are two sources of electrical phenomena which it should be the aim of the physicist to study, the one being that condition produced by the earth in its revolution in its orbital path at the rate of 1,140 miles a minute, the other that resulting from the diurnal revolution of the earth on its axis at the rate of seventeen miles a minute. The former is also subject to certain conditions different from that of the latter, in that the vacuum must be higher.

It may be that the velocity of 1,140 miles a minute is beyond the range of mechanical possibility, but there can be no serious mechanical obstacle to constructing a machine capable of giving a velocity of seventeen miles a minute or over. There are mechanical appliances now in use giving a velocity of 20,000 revolutions a minute, and it will be safe in making calculations if they are kept within that limit.

A three-foot plate having a nine-foot circumference revolving at the rate of 10,000 a minute would give a peripheral velocity of 90,000 feet per minute, which would be about the velocity at which the earth revolves. Such a sized plate might be inconveniently large, but a two-foot plate revolving at 16,000 revolutions would give a similar result.

A not unimportant question arises as to the substance of which the revolving plate or plates should be made. A number of these suggest themselves as being suitable for that purpose, but it would be better that this matter be left to be decided by actual practice should the rubber plates, which are at present in use, be found unsuitable. In physics very slight changes may produce very important differences in results. No one could have anticipated the extraordinary discoveries which have been made by the lessening of the air pressure through which an electrical discharge takes place, and with electrical machines running at extraordinarily high velocities, it is quite impossible to foresee the results that may be attained, and observation leads me to believe that there will be found to be a ratio or proportion between mass, velocity and the resulting electrical disturbance.

As the suggestion here made is an effort to follow up indications, it must not be forgotten that there are other conditions which attend electrical disturbances of this character. These are more or less diminished pressure, dryness and low temperature. These three conditions, combined with high velocity, hold out the promise of new discoveries. In this connection it must not be forgotten that the induction machine has given the hint, but that our experimenters have been slow to follow it.

In this new and untrodden field it is impossible to tell what results will be obtained, but there is every reason to suppose that much that is unexplained might be cleared up, and that new discoveries in this fascinating field of investigation might be made, and this paper is submitted with the hope that those members of the Association who have at their disposal the apparatus necessary to make such investigations, may be induced to follow up the suggestions here made.

DISCUSSION.

Professor A. E. Dolbear, of Tufts College, Mass., said that he took a very great personal interest in this subject, both philosophically and experimentally. Instead of offering a criticism, he would state his understanding of some of the factors mentioned in the paper as being present. He had understood the author to say that atmospheric electricity might be due to the diurnal and

annual motions of the earth through the ether. The author suggested that the high velocity of the earth might be the cause. From an astronomical standpoint there were certain very definite data at our disposal. In the first place, so far as experimental knowledge went, no motion of the earth, either daily or annual, was subject to any observable friction. We had, however, evidences from other sources. Some comets had come into the solar system with the velocity of four hundred miles a second. It was not known that they had been retarded in their motion to the least degree; they would go for a hundred years in space, and come back again exactly on time, which they would hardly do if there were any appreciable friction. The same might be said about the earth. Astronomers tell us that the earth has not lost one-hundredth of a second of time, due to friction in space, in the last thousand years. Now, if there was friction in the ether, due to the movements of the earth, we would expect some slowing up of the earth in the course of two thousand years. In the next place, in order to develop electricity there must needs be energy spent in some way—mechanical, chemical or in some other way. In the case of the movement of the earth there is motion without energy; the process may continue for a thousand years, and the earth would have just as much energy as at first. Wherever electricity manifests itself it shows energy, and it must get a supply of energy from somewhere.

Regarding its application to thunder-storms, he would say that the motions referred to in the paper had great uniformity, whereas thunder-storms were very erratic in number and time of appearance. There was, however, one exception to this, *i.e.*, they were always found on the south-eastern quadrant of a cyclonic disturbance, at a distance of three or four hundred miles from its centre, if they occurred at all. The Weather Bureau now foretells these disturbances, and warns those situated on the eastern side of the storm centre that they must expect thunder-storms.

Regarding the relation of the ether to electricity, the speaker said that if there were any such thing as a perfect non-conductor of electricity, the ether was that thing. Take, for instance, the very best Crooke's tube; exhaust the air from it, step by step, and continue

to pass an electric spark through it. At first the spark would pass with difficulty; then it would go more freely until it reached a certain degree of exhaustion, when it would lose its ability to transmit a spark at all. When the vacuum was still more perfect, the spark could not be made to jump one-eighth of an inch, whereas the same current would cause a spark to jump a long distance outside of the tube. From this it would seem that the ether was not a conductor of electricity at all. Electro-magnetic conditions are one thing, but a current of electricity or an electric spark is a very different thing. Electric induction might take place from bodies very far apart. If the sun were a magnetic body, and the planets similarly so, they would affect the earth. The earth is known to be a magnetic body, and it is bound to affect them, and it does this by electro-magnetic induction through the ether.

Dr. NUNN said that he thought he was about on the same line with Professor Dolbear, although the latter did not think so. He would not for a moment discuss where energy comes from; he did not care what system of philosophy was advocated. We were all brought up squarely against one wall, the first cause. He had not yet arrived at that particular acme of perfection which enabled him to distinguish between magnetic and electrical induction; electricity was converted into magnetism and magnetism into electricity. All these manifestations of the disturbances of the ether were, to his mind, the same thing. All that he had intended to say was that the disturbance of the ether was produced in some way or other. As we were talking about an unknown field, it was difficult to make himself understood. He had not referred to the local effects, such as local thunder-storms, but had endeavored only to consider the subject in a broad way. The ether, of course, is a non-conductor; if it were a conductor, we would get no effects.

Professor DOLBEAR said that he understood that the paper dealt with the origin of atmospheric electricity. Wherever electrical phenomena were apparent, or wherever electricity was generated, without any exception there were always at least two different kinds of matter involved with energy spent in some way between them. In a galvanic battery it might be two different metals; in the case of the thermo-electric battery, we might have

two different metals joined, and the junction heated, etc.; but in every case there must be matter of two different kinds, or if only one element, one of the pieces must be in a different physical state from the other. The atmospheric electricity had an enormous potential, giving a spark perhaps a mile long. What was the origin of this? In the clouds were to be found watery vapor—H_2O—also oxygen and nitrogen in varying proportions, with a small quantity of carbonic acid. The temperature of this material was not uniform, depending upon the height and other causes. This vapor was driven by the winds, and condensation took place as a result of falling temperature. If the temperature fell, thermal energy was being spent. It manifests itself in one way by heating some other body. It must lose its heat when it cools, by conduction and radiation, and by a third way, *i.e.*, when condensation takes place at a rate exceeding that at which the temperature can be radiated away, by a development of heat. We had a heat form of energy, and this heat form of energy was most easily convertible into electricity. It seemed to him very probable that wherever atmospheric electricity was generated, condensation was going on at a more rapid rate than conduction or radiation could take care of it.

Dr. THOMAS BLAIR, of Harrisburg, Pa., said that on a number of occasions he had noted that when a Leyden jar was charged to its full capacity and placed in a room filled with the very dry air, it would take a certain number of hours to lose its charge again; whereas if the jar were put in the moist open air, the charge would be lost very much more rapidly. Now, if the earth were looked upon as a Leyden jar having a certain charge of electricity surrounded by watery vapor, this vapor would become charged with the electrical energy generated on the surface and in the interior of the earth, and in the objects of the earth. He had also observed, where there was a discharge of steam from a vent in a boiler, that electricity was generated as a result of the friction from the passage of the steam through the small opening; but the spark was drawn not from the boiler, but from the steam which was entirely separate. At one time, while a belt was running rapidly over a wheel and was charged with electricity, steam was allowed to escape over this belt. As a result, there was an

electrical discharge through this vapor to surrounding objects. It seemed to him that the turning of the earth rapidly through space would generate electricity by friction, which would be almost entirely on the surface of the earth. The atmosphere at the height of, say, ten miles would be revolving not nearly so rapidly as that close to the earth. Outside of the questions raised by Professor Dolbear, there would be very little electricity developed by friction between the ether and the atmosphere. Again, where was there a distinct line of demarcation between the ether and the atmosphere? The speaker said that at one time he had observed during mid-winter, in a high altitude, that there was an *upward* flash of lightning, and a very vivid one. It occurred with very little noise, however. He reasoned on this account, that in winter there was a great deal more electricity generated than we had any conception of. To his mind, the earth must necessarily produce a great deal more electricity than the comparatively small ring of atmosphere or clouds surrounding the earth.

Dr. G. B. MASSEY, of Philadelphia, Pa., said that it should be understood that the absence of resistance to the progress of the bodies in the universe was the essential point in the Copernican system, now only about four hundred years old.

Some Thoughts and Suggestions on X-ray Work.

By Eugene R. Corson, B.S., M.D., Savannah, Ga.

The many vistas to be opened up by the magic of the X-ray—that dark light which penetrates as does no other light—cannot be foreseen. Fascinating to all must be the wonders which it has thus far revealed. It has invested with a new interest the familiar and the commonplace, and has brought us a new message of the power of invisible agencies. With all the experiments and speculations as to the nature of the X-ray, the whole question, to my mind, has been sifted down to this, that the burden of proof must rest with those who deny an etheric vibration similar in *kind* to all other etheric vibrations as at present known. The fact that no polarization and no phenomena of refraction have been discovered is but a fact, and proves nothing but itself. From the time of Crooke's experiments with radiant matter, the X-ray was daily before us, yet it waited twenty years for a discoverer. We may well wait twenty years again for the proof of what is more than probable. I myself believe that before that time the X-ray will be brought into line with the other etheric vibrations as at present known. It is a fact of great significance that Von Helmholtz, whose genius penetrated so far into the realm of molecular physics, predicted the possibility of an etheric vibration having not only the properties of the X-ray as now known—an ultra-ultra violet ray—but also of vibrations smaller than the molecule, with greater penetration even than the X-ray. We may yet have a Crooke's tube made out of a substance of greater molecular density than glass, whose radiations will penetrate steel as the X-ray now penetrates wood.

The artificial conditions under which the X-ray is generated, make it in a way an artificial mode of energy, not capable of long activity under extra-vacuous conditions. As the eye is attuned to etheric vibrations within a certain range, so the ether of the space about us is attuned to its own etheric gamut, and permits no extra strain for long. I have come to look upon the X-ray as a variable X, ever varying from the moment of its generation,

especially after it leaves its vacuum, when it rapidly fades out. May not the X-ray energy, in fading out, come down the scale to a rate of vibration more comparable to the ultra-violet ray, and may not its waves be measured just before they reach this point? Have not experiments towards polarization and refraction been too close to the tube? May there not be a point in their course, some distance from the tube, where they come within the control of present methods? These are questions, of course, for the skilled physicist to answer and decide. Coming from me they are, perhaps, but idle thoughts from idle moments, and I give them for what they are worth.

My own line of X-ray work has been chiefly with Colles's fracture, already embodied in two papers in the "Medical Record," and in a study of the natural movements of the bones of the wrist-joint, researches which I hope shortly to bring out in a separate paper. I believe that some doubtful points as to the nature and treatment of Colles's fracture have been quite definitely settled by the X-ray. I also believe it will clear up many mooted points in regard to the movements of the several bones which make up the wrist and carpus. A large field is offered to the investigator in the study of all the joint movements. My experience has been that the X-ray will prove even more valuable in dislocations than in fractures. I may mention here that in a case of dislocation of the humerus forward on the radius and ulna, of nearly three weeks' duration—when the great swelling present and the absence of the other arm for comparison made a correct diagnosis quite impossible—the X-ray showed clearly the nature of the injury and enabled me to reduce the dislocation. The patient was sixty years old.

I would offer a suggestion in the study and reproduction of radiographs. In many cases a careful outline tracing of the negative by transmitted light, all other light being shut off, gives a simple and striking illustration which tells its own story. By this method the non-essential is wiped out, and the eye can better take in the salient and essential parts of the picture.

I have made some investigation into the differential diagnosis of rheumatism and gout by means of the X-ray. The thought is not original with myself, as I had seen somewhere that a French physician had noticed the X-ray's greater penetration of urate of

soda than of bone or its salts. To show this in a striking way, I packed tight into four similar pill boxes, bone dust, phosphate of lime, carbonate of lime and urate of soda, and subjected them to one minute's exposure of the X-ray. The radiograph shows in a striking way how differently these substances affect the X-ray. The bone dust gives the darkest shadow, then carbonate of lime, and phosphate of lime, and urate of soda last, where the shadow is as light as that cast by the web between the fingers. I have had but one case diagnosed as rheumatic gout where I could study these differences. They were very beautifully shown. It could be plainly seen where deposits of urate of soda under and in the periosteum had caused osteophytic growths over them, and where the soft tissues, greatly swollen by urate of soda deposits, gave slightly, if any, darker shadows than the normal soft parts.

I have seen several published radiographs of gouty hands where this property of the urate of soda was beautifully shown, but where no mention of it was made by the writers. See, for example, the "Medical Record" for this year, page 591, and the "Medical News" for April 17th, 1897. In the latter the radiograph is a poor one; the X-rays were weak and the definition is poor.

I would emphasize the principle that the nearer the bone to the plate the sharper, of course, is the shadow. In the taking of radiographs this is often forgotten, and convenience more than the proper position is regarded. As a rule the extension surface should be selected.

It occurred to me that a fluoroscope could be constructed, having a flexible screen strong enough to be pressed firmly over the surface to be examined, and capable of adapting itself to the inequalities of the surface, and thus brought nearer the object to be shadowed. I suggested to the instrument makers a screen made out of parchment or the skin used in drum heads, and set in a thick rim of rubber which would permit considerable displacement and firm pressure on the surface examined. I was informed that this could not be done, that the only solution of the problem was to have a set of fluoroscopes of different curvatures to fit the different surfaces. I still believe my idea can be carried out.

A *small* barium-platino-cyanide fluoroscope, say, 3 x 4 inches, is the best. It is stronger, permitting firmer pressure, and the

smaller field gives a better definition. A good guide as to the definition is the ability to make out the styloid process of the ulna. I have never been able to see it properly with the tungstate of calcium fluoroscope.

I have never seen any injury from the X-ray, though exposed to it myself frequently. I cannot see that the X-ray has anything to do with it, but should ascribe the trouble to electro-static effects, to the streams of electrified particles which come off from the tube. So long as you are sufficiently far away from these latter influences, no matter how powerful the X-ray effects may be at that distance, there is no danger. Some experimenters are constantly having trouble, and I explain this difference by the different forms of apparatus used and the way the tube is worked and the exposures made. A tube worked too high is more dangerous than one worked only to its point of X-ray energy and capacity. One has but to bring the finger within the electro-static breeze of the tube, or close enough to bring sparks, to be assured of this.

I have seen as yet no evidence to assure me of injury to bones by X-ray exposure. The case described by Prof. T. C. Gilchrist, in the Bulletin of the Johns Hopkins Hospital, February, 1897, where, he thinks, the radiograph shows bone or periosteal inflammation, seems to me a quite unwarranted conclusion. The differences between the radiographs of the two hands are easily enough explainable by the natural differences between the right and left hand. The bones of the right hand, which happened to be the affected hand, are only somewhat larger than the left, and give no evidence of disease. The importance given to the darker shadows of the bones of the affected hand is equally unwarranted. For this difference to be due to mere bone thickness would require bone of twice the thickness to give that much difference in the shadow. Further, we all know how frequently the X-ray conditions vary from minute to minute, and that two radiographs of the same hand, taken in quick succession, and under apparently similar conditions, vary greatly in intensity of bone shadow as well as general definition. I dwell on this paper especially, as much importance was given to it at the time as proof of bone lesions from X-ray exposure. The radiograph gives not the slightest evidence of this deep inflammation, nor was the writer justified in ascribing the symptoms present to bone lesions.

I offer to the Society these few thoughts and suggestions, the result of my own private work, fully conscious how limited such work must be in comparison with that conducted with the resources of a physical laboratory, where the many thoughts which crowd on one in this fascinating work, can be experimentally tested.

DISCUSSION.

Dr. G. B. Massey, of Philadelphia, Pa., said that by this time considerable evidence had accumulated regarding the injurious effects of the X-rays. Apostoli had had a case in which, after a simple examination of the stomach with these rays, a gangrenous inflammation had been produced and had required a whole year to heal. This case had been published in a French journal. We should ever bear in mind the potency of this agent and the dangers attendant upon its use. He had thought that X-rays developed from static machines were not as likely to cause such injuries as those produced by means of induction coils. However, he had partially disproved this by one case in which a mild dermatitis of the scalp had developed after the use of the rays developed from a static machine. The hair entirely fell out, and the skin underneath was distinctly inflamed. In this case the treatment had been continued for some time, and the X-rays had been produced by a very powerful static machine of eight plates.

The Early Electrolysis of Nævus.

By CHARLES R. DICKSON, M.D., Toronto, Canada.

When a nævus is observed upon an infant, I am frequently asked by the attending physician, "When should this be operated upon, in the early months or later in life?" and my reply is, other conditions being satisfactory, "Let it be attended to as soon as possible." The operation is simplified thereby, less tissue requires to be destroyed, and the resultant cicatrix, if any, will be less perceptible and will fade away as the child grows. In illustration of this permit me to cite two cases:

C. L., aged 19, was referred to me by his physician for the removal of a very vascular nævus of the right upper lid, existent since birth, $1\frac{1}{4}$ inches long by $\frac{3}{4}$ inch wide, causing the upper to overhang the lower lid, almost closing the eye and causing atrophy of the lower tarsal cartilage, and extending a short distance beyond the outer canthus. There was also a growth beneath the palpebral conjunctiva about $\frac{3}{8}$ inch long by $\frac{1}{4}$ inch wide and about $\frac{1}{8}$ inch in thickness, and over it the conjunctiva was very vascular.

On February 25th, 1895, I used a positive needle in the outer canthus $\frac{1}{2}$ inch deep, the negative electrode being upon the abdomen, with 5 to 10 m.a. for twenty minutes.

On March 4th, the abdominal negative being again used, a positive puncture was made through the central and most projecting portion of the growth towards the outer canthus with 3 m.a. for seven minutes, and 7 m.a. for five minutes, and then to free the needle the current was reversed and 3 m.a. for five minutes employed; but oozing having started as the current was turned off and 5 m.a. for five minutes further failing to check it, a second reversal (needle positive) 5 m.a. for five minutes was successful.

On March 20th the same portion was attacked, the needle being carried obliquely upward and outward, a positive puncture, 10 m.a., for five minutes.

On March 27th, with the positive needle the conjunctival

growth was transfixed above the outer canthus, the lid being averted, 5 to 20 m.a. used for fifteen minutes, and reversing (needle negative) 10 m.a. for three minutes.

On April 2nd the negative needle was used in the conjunctival growth, 10 m.a. for ten minutes and 20 m.a. for five minutes.

On September 11th both needles were inserted and 10 to 30 m.a. used for twelve minutes and 50 m.a. for three minutes.

The growth was also attacked along the same lines on March 10th, 1896, March 26th and September 9th.

The young man's physician reports, on July 22nd, 1897, "There is still a varicose area on the upper eyelid and a little at the outer angle of the eye, but it is not at all increasing in size, and the result as it is now is to my mind most satisfactory, and I have personally to thank you for your care and treatment of the case." When I last saw the young man he was able to open the affected eye as widely as the other, and the atrophied cartilage was increasing in thickness.

In contrast to this tedious and somewhat anxious case, let me cite another.

The parents of F. S. were referred to me by an oculist whom they had consulted, for my opinion as to the advisability of attacking a very disfiguring, vascular, projecting nævus the size of a small bean on the left upper eyelid of the child, and thought by the oculist to extend behind the orbit. The child was eight months of age. My advice was immediate treatment and I operated at once, on April 15th, 1892.

The positive electrode was placed upon the back and a negative needle inserted in the growth, carrying it in all directions through the nævus and using 5 m.a. for forty-five minutes.

The result was all that could be desired, and on July 19th of the same year, I used 1 m.a. for fifteen minutes to complete the paling out of the nævus.

The child is now six years of age, and the closest scrutiny fails to discover any trace of the former disfigurement.

This is a very happy contrast to the cases met with in later life where the tissues are more matured; here the operation is much more prolonged and the fear of extensive sloughing and large cicatrices ever facing you.

DISCUSSION.

Dr. ROBERT NEWMAN, of New York, said that he knew of no operation which was more difficult than that for nævus, in either small or older children. The reason for this was that the slightest mishap would cause disfigurement for life. He had treated many such cases by electricity, and with success. The exact number of milli-amperes could not be stated at the outset; the case must be watched and the polarity and amperage changed from time to time. The rule should be to use the positive pole if it were desired to destroy the nourishment about the artery and veins, and the negative pole if the desire of the operator was to cause absorption. Great difficulty was experienced in getting the right kind of needles. They should be made of platinum, for iron would cause bad discoloration. Platinum by itself was too flexible; an alloy of platinum and iridium was better. Again, if the current used were too strong the nerve might be injured. After much inquiry, he had succeeded, by the aid of an instrument maker in Providence, R.I., in securing just the right kind of needle, made of an alloy. It was also important to have the needle properly insulated, otherwise disfigurement would be produced at the point of entrance of the needle. Where the positive pole was used to cause occlusion of the blood vessels, it would be found that the needle would be held so tightly in the tissues that its removal would cause tearing of the tissues and hæmorrhage. The needle could be removed, however, without injury by changing for a moment to the negative current.

Dr. G. BETTON MASSEY, of Philadelphia, Pa., said it was interesting to note that the author of the paper had treated his second case with the negative pole. This seemed to him to be advisable wherever it was possible to do so, for the positive pole was much more likely than the negative pole to produce a scar. Anyone living near a wholesale dental establishment could readily obtain a platinum-iridium needle, and the "cold drawn" needle was the better. He had found it desirable in some cases to pass the needle flat beyond the nævus, as in this way there seemed to be less adhesion and hæmorrhage. His experience had suggested the advisability of employing a strong current in some cases. It

might, at times, be necessary to use from forty to sixty milliamperes under general anæsthesia. It had occurred to him that one might amalgamate gold with mercury, so that the mercury would act as a lubricant and prevent adhesion.

Dr. R. J. NUNN, of Savannah, Ga., said that at the very first meeting of the Association he had exhibited some needles made of platinum and gold. He had used these for twenty years previously, and ever since then. They were sufficiently hard for most purposes. The needle should always be inserted while the negative current was passing. If this were done, even with a very soft needle, little difficulty would be experienced in its introduction. He never used any particular quantity of current; the current should be increased to whatever the patient could bear, and kept at this point until a bleached zone appeared around the needle. By following out this plan, the process could be carried out completely without anæsthesia.

Dr. D. B. D. BEAVER, of Reading, Pa., said that he had understood the speakers to say that these operations were carried on without causing scars. This had not been his experience. He had used electricity in the treatment of both small and large nævi, and although his experience had been large, there had always been left more or less scarring. The skin would be thinner than in the surrounding parts, even were the skin itself had not been touched. He recalled the case of a nævus on the arm of a child. In this case, the needle had been introduced at the edge of the nævus into the blood vessels under the skin. The blood vessels were destroyed gradually, yet over the site formally occupied by the nævus the skin fell down and was thinner than over the surrounding parts. If a needle were passed through the skin, and sufficient current were employed to destroy the blood vessels under the skin, there would be sufficient current to cauterize and destroy the skin immediately around the nævus, and this would necessarily cause a scar of greater or less dimensions. The same thing was observed in the little operation of destroying hairs, no matter how fine the needle, or whether the puncture was single or multiple.

Dr. MASSEY said that by proper insulation of the needle scars could be avoided.

Dr. NEWMAN said that he had never yet had a cicatrix left.

He admitted that for a time the skin might be inflamed, but this would heal over, just as it would if the face had been blistered. If, however, the skin were destroyed deeply, then a cicatrix must necessarily result.

Dr. DICKSON said that he had worked under favorable circumstances, because his colleagues promptly referred many cases to him for electrical treatment. As a rule, where the tissues were very redundant he employed the positive pole to destroy these tissues. The negative pole was used to promote absorption. Before operating upon any nævus he made pressure to ascertain if there were not one point pressure on which would control the circulation. If such a point were found, he inserted the negative needle there, and the bubbles of hydrogen gas generated followed the blood current through the arteries. These bubbles of gas acted as foreign bodies, and by their mechanical effect obliterated the capillaries. He aimed to make the punctures in the line of the natural furrows of the face. He always carefully insulated the needles with the *plain* collodion (not the flexile), and took care that the uninsulated portion did not come in contact with the skin. Two coats of collodion would be sufficient, provided the first coat was allowed to dry thoroughly before applying the second one. He used rather hard platinum-iridium needles manufactured by the Kidder Company. Their introduction could be facilitated by a slight twisting motion. He always employed anæsthesia with children, for there was too much risk in operating without anæsthesia and the full control of the patient. The current strength varied greatly with individual cases. He had mentioned the current strength in his paper because he thought it but right that this should be given with exactitude in the reports of cases so as to serve as a general guide. With the small nævi he had failed to get any appreciable scar.

The Expenditure of Electrical Energy.

By Margaret A. Cleaves, M.D., New York.

The data accompanying this paper and furnishing the groundwork for the same were submitted, with the notes used by the writer in her clinical lectures, to the Association at its meeting in Boston, September, 1896,* but owing to a serious illness the paper was not put in shape for publication in the Transactions of that year. As similar data to those gathered together here, have not, to the writer's knowledge, been brought to the attention of the profession, the paper is presented in detail at this meeting.

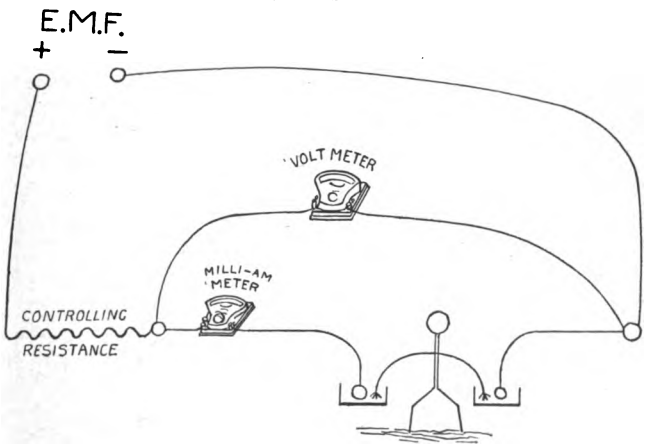
Thus far the only published record of similar work is to be found in the report of Committee on Meters, 1894.† In that report are embodied some of the writer's earlier and less complete observations. These observations have extended now over a period of more than three years. During that time volt and milli-ampere meters have been in constant use in her office, and for over two years in her clinical work as well.

To the physician whose daily electro-therapeutic work is carried on with a volt meter as well as a milli-ampere meter in circuit, the fundamental characteristic of electricity, viz., *pressure*, becomes immediately a self-evident fact. While this may be a perfectly familiar truth in the abstract, it is impossible to have that clear perception of it which arises from the use of the means for its actual demonstration and measurement. So long as there is recognized in electro-therapeutic work only the rate of flow in milliamperes, it is not possible to have an intelligent conception of the force by means of which we make electricity available or of the laws governing its action.

Whenever connections are made between the source of an E.M.F. or pressure (whether provided by chemical generators or dynamos) and the volt meter, the needle swings to its place with certainty and precision, demonstrating the existence at the terminals of a pressure (potential difference) whose expenditure is

* The New York Electro-Therapeutic Clinic, Laboratory and Dispensary.
† Transactions American Electro-Therapeutic Association, 1894.

capable of producing definite results, just so surely in electro-therapeutic work as in electrical engineering. Without a volt meter there is no means of accurately determining the existence of this pressure. Who has not completed the conducting circuit to find that when the "current is turned on" the milli-ampere meter needle does not move at all, or else after a moment swings abruptly forward, because resistance interposed in the circuit, perhaps due to an imperfect contact, has been suddenly overcome? There is thus caused a sudden expenditure of energy in the patient's circuit, resulting in severe shock and physiologic harm. With a means of determining the presence of this initial pressure,



and whether it maintains itself steadily, or whether from imperfect contact a variable E.M.F. exists, indicated by the fluctuations of the volt meter needle, all question of trouble, in so far as the pressure at the terminals is concerned, can be eliminated before the conducting circuit is completed. If when the latter is accomplished and resistance placed in the circuit there should not promptly be established a rate of flow as indicated by the milli-ampere meter, the operator does not need to go back of his conducting circuit, *i.e.*, conducting cords, electrodes and patient, to determine the whereabouts and nature of the trouble.

The above diagram represents the manner of connecting the volt meter in circuit, so as to secure the necessary readings.

The connections of the volt meter are across the electrodes, eliminating thereby the resistance of the controlling device with which our batteries and adapters are usually provided.

When connections are made for work there are certain facts to be observed from which certain others are to be calculated, in order that we may have some definite idea of the force with which we are dealing, of the expenditure of energy, and of the resistance of the obstructions in the conducting circuit.

This brings us to the two grand divisions of our charts, namely, *observed* and *calculated* facts.

Under the head of observed, we have, first, the *source at the terminals*, or electromotive force in volts.

As you will see from an examination of the charts, this varies greatly. The work was done with the Kennelly adapter, and the varying pressure obtained by shunting the excessive voltage through the lamps provided for that purpose ; and as in some instances, the adapter was connected directly with the Edison incandescent or direct current circuit, and in others with a motor dynamo, the result is a pressure at terminals of considerable variation--say, from 15 to 120 volts.

With the direct current from the Edison incandescent circuit, the electric pressure, or E.M.F., varied at the terminals from 115 to 120 volts. With the motor dynamo, converting a Thomson Houston alternating current at 104 volts into a direct current, the E.M.F. at the terminals varied from 40 to 60 volts. Whatever our equipment, with the existence of this *potential difference* in volts demonstrated beyond question, its expenditure becomes at once a matter of actual observation.

An E.M.F., we know, is often likened to the pressure or head of a body of water—a reservoir, for instance. As we have seen, the E.M.F. is the initial thing, and relates to that force which is capable of establishing an electric current under suitable conditions.

Nor is it possible to have an electric current without a difference of potential. As water flows from a higher to a lower level, so the electric current is assumed to flow from a higher to a lower potential.

In order to secure and maintain a potential difference it is necessary to connect the initial pressure with a conducting path or

circuit in which we wish to do work. And wherever we wish to do useful work there must be placed in the conducting circuit an obstruction or resistance. This we have in the person of the patient forming a part of our conducting circuit, as well as in the milli-ampere meter, conducting cords and electrodes. In overcoming this resistance or obstruction in our path a part or perhaps the whole of the initial pressure may be expended.

"At every point in such a path, or more accurately, between the two points—no matter how large or how easy the path may be—some fraction of the total pressure has been expended in exact proportion to the opposition it met, or in other words, to the resistance which it encountered."* Were it not for resistance in a circuit no work would be done. In the path of the pressure expended on the tissues of the body the same law applies as in electrical engineering. The volt meter needle indicates promptly and definitely the standard of pressure which can be relied upon to initiate and maintain this expenditure of energy, and thus we are able to record the second of our observed facts, viz., the *available potential difference* or *available E.M.F.*, if you will.

This available difference of potential falls in value as the current flow increases, and if we will think of that current flow which we call milli-amperes, or fractions of an ampere, as the expenditure of volts per ohm of resistance, just as the expenditure of certain muscular force, moving a definite weight, results in a certain rate of work which we may call foot pounds, the fall in value of the potential difference as the current flow increases will be readily appreciated. In the latter instance the expenditure of muscular power leaves less for further efforts (a potential difference, or a difference of potential). In the same manner using up a variable proportion of the E.M.F. in overcoming a variable resistance gives a variable remaining difference of potential.

Before the resistances of the patient and contacts are placed in circuit, the E.M.F. of the dynamo current (for instance) as registered by the volt meter, will be, say, 52 volts. These 52 volts do not represent the entire E.M.F. of the dynamo, as there is a little loss in the voltage due to the resistance of the armature, or

*"Current Distribution," by W. J. Jenks, E.E. Transactions Am. Electro-Therapeutic Association, 1894.

what is known as the "internal drop," and also an additional loss in the conducting circuit as represented by the insulated wires running from the dynamo to the room in which the adapter is placed.

Now, the 52 volts which were shown by the volt meter, when the dynamo was set in motion, is the *initial pressure*, *E.M.F.*, or, as per our charts, the *source at the terminals.*

As the resistance is overcome there is a current flow, as the case may be, of .010, .015 or .020 of an ampere. When this rate of flow is established it is found by observation that the volt meter registers, say, 46 volts.

The amperes, whatever their number, give the rate of expenditure of volts per ohm independent of time, or as is commonly said, the rate of flow. The 46 volts is the actual working pressure or E.M.F., *i.e.*, the available potential difference at the electrodes (volts), the rest having been consumed in overcoming the resistance of the conducting circuit, *i.e.*, the milli-am meter, conducting cords, electrodes and patient.

The 6 volts used in overcoming the resistance of the circuit is called "the drop." A part of this pressure has been expended on the conducting circuit other than the patient, and is known as "conductor drop," and a part on the patient in doing "work." If there is added to this the potential difference 46 volts, or 46 plus 6, we have the total E.M.F. of the circuit external to the dynamo. The resistance of the milli-ampere meter, as well as conducting cords and electrodes, is practically negligible, however.

On expending a part or the whole of this initial pressure in overcoming the resistance of our circuit, and in doing useful work, a current is brought into existence, as we have seen, which our milli-ampere meter needle promptly and accurately registers, and which we record under the head of *milli-amperes* as the third of our observed facts.

This expresses the rate of expending volts per ohm of resistance, or, in medical applications, of milli-volts per ohm, and is usually the only measurement recorded by the electro-therapeutist.

Given, then, a working E.M.F. or available potential difference, and the rate of flow in volts per ohm of resistance, it becomes only a matter of calculation to determine the resistance of our

conducting circuit, for the E.M.F., divided by the C.S., gives us the resistance in its unit of measurement or ohms.

This brings us to the second broad division of our charts, where we find that there are certain facts which, instead of being observed, are obtained by means of calculation, and the first of these is the *body and contact resistance* in *ohms.*

This, as a step on our way for the resistance of the human body in health and disease, promises to be a matter of great importance to the physician.

It has been suggested by a well-known physicist* "that an accurate knowledge of the resistance from point to point of an average human body might assist occasionally in the diagnosis of disease, and the comparison with the resistance of a corpse might have useful results to show."

But as yet, however, our conception of the expenditure of electrical energy is very inadequate, for our only measurement thus far simply expresses the rate of flow in m.a., and conveys no comprehension of the rate at which we are doing work in the tissues. This can be only determined when the total expenditure of potential between the two given points in the electrical circuit is found and multiplied by the rate of such expenditure in each unit of resistance between the same two points ; or in other words, when the volts are multiplied by the milli-amperes we secure a product in volt-amperes, or better, in the unit of electrical power, *watts.*

By this process the rate at which we are doing work or expending energy in the treatment of a given condition, whether a uterine fibroid, pelvic exudates, or a wasted muscle, wherever or whatever it may be, is determined. But it is desirable that we should know not only the *rate* at which we are doing work but the total *amount* of work done. To secure this aggregate it is necessary to add still another factor.

By recording the observed *time* of an application (see fourth division of observed facts of our charts, or "time in seconds") it becomes at once an easy matter to obtain the total energy expended in the tissues ; for the rate of work, the volt-amperes or watts, multiplied by the time in seconds, will give us the *total amount*

* A. E. Kennelly.

of work done, the volt-ampere-seconds or joules. By referring to the third division of our second broad division we find recorded the total amount of work done (energy expended) in these units of work or *joules*.

This may be in heat developed, as in cautery applications; it may be in mechanical work done, as with alternating currents, or it may be in chemical action, as in applications of the direct current.

The rate of work, as well as total amount of work done, can be calculated in fractions of a horse-power or foot pounds, if it will convey any clearer conception to our minds of the rate of expending energy or the total amount of energy expended within the tissues. But the sooner we come to think in electrical units, however, with a definite idea of their meaning, the sooner will we do our work understandingly and advance the cause of scientific electro-therapeutics.

Perhaps it may not be undesirable before further considering the expenditure of electrical energy in the human body to briefly recapitulate here the definitions of the less frequently used units of measurements.

The joule is the international unit of work, and is nearly equal to .738 foot pounds at the latitude of Washington, or in other words, one joule of work will raise a pound of matter at the latitude of Washington through a distance of .7381 foot. Or again, one foot pound is an expenditure of work equal to about 1.355 joules.

The watt is the internal unit of activity or power, or of the rate of working per second of time, and is an activity of one joule per second. That is the force that will raise one pound at the latitude of Washington through the distance of .7381 foot in a second, expends work at the rate of one watt, or one joule per second.

The horse-power repesents an activity of 550 foot pounds per second at Greenwich, or 746 watts; so that one horse-power equals 0.746 kilo-watts (kilo-watt, *i.e.*, 1,000 watts), *i.e.*, one kilowatt equals 1.34 horse-power.

It is important that there should be clearly understood the difference between work or energy expended (joules) and activity or power (watts). Work (*i.e.*, joules) is a measure of the expenditure of energy, and is equal to the product of a force and the

distance of time through which that force acts. Activity is the rate of expending energy (watts) or doing work, and is found, or at least averaged, by dividing the work done in a circuit, or a portion of a circuit, by the time occupied in doing it.

When weight of one pound is raised through one foot, whether it be raised in a minute or in a second, the same amount of work is done, but in the latter case the rate at which the work is done or energy is expended is sixty times greater than in the former.

Suppose a mechanical energy that is capable of raising 33,000 pounds one foot in a minute. This equals one horse-power. It will be readily appreciated that here a tremendous force is exerted, and one which is capable of producing a serious injury to anything that may come in its path ; but suppose that 33,000 pounds to be raised one foot in a period of time from five to ten minutes, more or less, one can readily appreciate that this immense force could be applied without tending to cause mechanical injury.

Thus we see that it makes a very great difference as to the rate at which the work is done. In the former instance just as much work was done or energy expended as in the latter, but at a very different rate.

Or, again, take the lightning flash, or an explosion of dynamite. If the same number of heat units which are in these cases exploded, perhaps in one-millionth of a second, could be so retarded in expenditure as to cover one second or one minute, no destructive action might be apparent. When lightning strikes a forest tree the inconceivable rapidity of expending a given number of heat units allows no time for gentle radiation, but instantly turns to steam the moisture in the tree trunk and beneath the bark, which then occupies 1,600 times the space which it did in the form of water, and the steam pressure become so terrific that nothing can withstand its outwardly expended energy.

With these examples it is easy to appreciate why there should be known not only the total energy expended, but the rate at which that energy is expended. Suppose a pressure or E.M.F. of 120 volts, and a current flow of 50 m.a. to be expended within the tissues uniformly during the period of one second of time, or during any other period, the rate of expending energy would be 120 x .050 volt-amperes, or 6 watts, and the total amount of

energy expended in one second would be 120x.050x1 volt-ampere seconds, or 6 joules. Such an expenditure of energy would have a tendency to disruptive action upon the tissues, and would be capable of causing great injury to them ; while a lesser E.M.F., say, 30 volts, a lesser rate of flow, say, 25 m.a., extending over a period of eight seconds, or again a pressure of 30 volts, but a still smaller rate of flow, say, 12½ m.a., extending over a period of sixteen seconds, would cause as great an expenditure of total energy, but one that would result in no disruptive action upon the tissues. On the contrary, the latter would prove an expenditure of energy which would not be felt in an appreciable sense, would cause no injury, and would tend only to the furtherance of physiological action of the part to which it was applied.

To summarize—

Force is a cause of change.

Energy is the power of doing work.

Work is energy expended (joules or volt-ampere seconds).

E.M.F. is measurable by the total potential difference at the electrodes (volts).

Current is the rate of expenditure of volts per ohm (amperes), independent of time.

Power is the rate of expenditure of energy, independent of time (watts).

It is essential, then, to know not only the *rate of flow*, as indicated by the number of m.a., but also the working E.M.F. (that is, the available potential difference at the electrodes) and the time of a given treatment, so as to be able to calculate the rate of the expenditure of energy and the total energy expended, not for the satisfaction of making such a calculation simply, but because, to promote processes by means of which it is possible to restore healthful function, the same total energy should be expanded slowly, so as to give the tissues themselves, to their minute constituents, *i.e.*, molecules and atoms, an opportunity to adjust themselves to the influence at work.

"We must bear in mind here that it is not the electricity itself which is directly effective, but that by its means there is conveyed to the proper point, a potent energy so flexible, so obedient to known laws as to result in a transformation to heat and chemical

action, or some other manifestation, *i.e.*, the energy peculiar to vital cells. And that energy should be expended at such a rate as to encourage this action, not militate against it, as would be the case in a sudden expenditure of the same amount." *

And that rate of expending energy or volt-amperes must be obtained by the expenditure of only such a pressure as is necessary to procure the requisite current flow through the obstructions placed in the path, or the resistance of the conducting circuit. We are thoroughly cognizant of the inadvisability of using the same muscular force—in other words, the same foot pounds—in handling a fragile microscope cover glass, as in the iron plate covering the manhole of a sewer or water main.

We know at once that the result would be disastrous to the cover glass. On the other hand we know equally well that the muscular force necessary to lift the cover glass will have no effect whatever upon the iron plate.

Physical laws are the same, no matter what the agency used.

There is therefore every reason why our apparatus, whether used with chemical generators or dynamos, should be so constructed that the pressure in volts can be carefully graduated from the fraction of a volt up to the full E. M. F. of which the generator is capable.

The blow that will cause the death of an eagle will not only take the life of the tiny humming-bird, but shatter it to atoms as well, while the power necessary to cause the death of the latter may have no effect on the former. Just so must our volt-amperes be regulated to the work done. The acute neuritis, as well as the acute and subacute pelvic inflammations, for instance, require the minimum rate of expenditure in volt-amperes, and it is not only the milli-amperes we must look to, but the volts as well. We may use 20x5 volt-amperes, or 5x20 volt-amperes in the treatment of a given condition. The rate of expenditure or watts is the same in both instances, but the action upon the pathological condition must be different. In the one instance the pressure in volts is in excess of that needed with which to do the work, and, expended along our conducting path, can only result in physiologic harm to the tissues involved.

* "Current Distribution," by W. J. JENKS, E.E., Transactions Am. Electro-Therapeutic Association, 1894.

In the conditions which we have just indicated nothing is to be gained by carrying our applications to the point of pain. We must remember that we are expending an energy within the tissues which produces a silent chemical change; that our purpose is to expend that energy in such a way as to exercise a directive influence upon the molecules and atoms, not to cause any disruptive action of which pain might be a manifestation, and that to gain our end it is not only wiser but necessary to expend fewer volts per ohm of resistance (or fewer milli-amperes) for a longer time. By increasing our time limit, the volt-ampere seconds or the joules are increased, but at no time is the rate of expenditure in watts, or, if you will, fraction of a horse-power, sufficiently great to cause pain or destructive action.

In the treatment of fibroid tumor or exudates, on the other hand, greater pressure is required, in order to overcome the resistance of the denser structures in the conducting path, so as to secure necessary current flow.

In percutaneous applications the proportion of the volts and amperes must vary considerably from their proportion in mucous membrane contacts. In the former, considerable pressure is expended to overcome the resistance with a minimum of current flow; in the latter, because of diminished resistance, less pressure is needed to secure the necessary rate of flow. In both instances, however, there may be the same rate of work or watts.

In our electro-therapeutic applications, however, there must be considered not only the expenditure of watts but the path of its expenditure. This brings us to a consideration of the density or degree of concentration of the current. The path of the greatest current density or expenditure of watts may or may not be in the most direct path between the electrodes. This will depend upon the pathology under consideration and the habit of the patient, as we shall see later on. However, as a rule we should expect that the densest current, in an intra-uterine application in endometritis, for instance, would be the most direct. Increasing the distance traversed by the current tends to an increase of the resistance, and as the expenditure is always in the lines of least resistance, the tendency would naturally be in the lines directly between the two electrodes. But in such an application, as usually carried out, the

greatest expenditure is on the anterior surface of the uterine canal, because of the direct path between that and the abdominal wall occupied by the surface contact or indifferent electrode. The expenditure on the posterior wall would thus be reduced to a minimum, because this would not be the conducting path owing to the greater distance to be traversed and hence greater resistance. To our failure to expend energy upon the uterine mucosa in its entirety must be attributed our failures in relieving existing pathology.

In consequence of this law it will be better in such conditions to use both abdominal and lumbo-sacral surface contacts with a bifurcated cord in order to insure as equal an expenditure of energy throughout the uterine mucous membrane as the character of the structures and their resistance will permit. It is not the agent which we use that is at fault, but it is our failure to adapt the means to the end. Electrodes are not constructed so as to produce complete contact, and our technique is at fault. It is not sufficient that energy be expended in the tissues—it must be expended in such a manner as to influence directly the diseased structures. And where this is a localized condition, as in a typical endometritis, at that point must be exhibited the greatest expenditure of watts.

For instance, in a vaginal hydro-electric douche with abdominal surface contact, a working E.M.F. of 40 volts and a current flow of 20 m.a., the energy expended in one second of time would be eight joules, but that energy would be expended throughout all the tissues of the pelvis. On the contrary, in the intra-uterine treatment of an intra-mural fibroid anterior, with abdominal surface contact, given the same available potential difference, the same current flow, there would still be in one second of time an expenditure of eight joules, but that energy would be expended or work done at the site of the internal electrode, *i.e.*, on the anterior uterine mucous membrane, and secondarily upon that portion of the intra-mural growth directly adjacent, instead of being distributed as in the former instance, over considerable areas of tissues.

These examples are multiplied in the charts which accompany this paper, and in some instances attention is called to them under the head of "remarks."

In a hydro-electric application, whether vaginal, intestinal, vesical or nasal, the idea is to distribute the current as thoroughly as possible throughout the diseased tissues.

We do not desire a localized application or expenditure of watts in a limited path, as, for instance, in an endometritis, a urethral stricture or hypertrophied turbinated body; but wish to distribute the expenditure through large areas so as to bring the entire pathological condition under its influence. In a pelvis filled with exudates, a foot or a hand the subject of a sprain, a rheumatism of a leg or arm, an articulation immobilized by exudative material or sheaths of tendons bound down by the products of inflammatory action, our aim must be current distribution, and to that end we utilize either electrodes of large square inch area, or warm saline solutions with which the part is filled or in which it is immersed. The saline solution becomes the electrode, carrying the current to all parts of the diseased structures.

We are not to think of the current as flowing in direct lines through the region between the two electrodes, but as seeking its way from its positive pole to its negative pole by paths which are often devious; just as we often hasten to our destination by unfrequented side streets, in order that we may escape the obstructions of the crowded thoroughfares. So is the E.M.F. of our electric source expended on the paths of least resistance, or in other words, those of best conduction. For instance, in a vaginal hydro-electric, vesical hydro-electric or intra-uterine treatment of a patient whose abdominal wall is thickly covered with fat, there is great divergence of the direction of the lines of current, because the fat itself is practically a non-conductor and only has conductivity by reason of the few blood vessels running through it. The energy is expended therefore along the paths of least resistance, through the interstices, as it were; the blood because of its fluidity and salinity affording good conduction.

If the patient be of a lean, muscular habit, there is less divergence of the lines of the current and greater current density, *i.e.*, greater expenditure of watts even with the same square inch area of electrodes, because the conducting medium being good, and affording practically the same resistance in all parts, the lines of the current will be more direct. There will be no seeking of side

streets or by-paths, as it were, but a straightforward push throughout the inter-polar region.

The greatest expenditure of energy is always at the point of greatest resistance, but if we wish to expend the energy at such a point, then we must so adapt our electrodes to the condition to be treated, that there may be offered little or no opportunity for any divergence of current flow, but a distinct localization within the prescribed limit. For instance, in epilation there must be had a minute, almost microscopical, localization of the current. A tiny steel needle is inserted into the hair follicle and attached to the negative pole. Action upon the skin is to be avoided. The indifferent electrode is placed conveniently near at hand so that as little resistance as possible shall be interposed.

In this application our desire is to avoid just as much as possible current distribution. Nothing is to be gained by it; on the other hand, there is much to be lost. If the indifferent electrode be large (from three to six square inch area is abundantly large), there is a greater diffusion at that point and greater current density at the needle than is expedient.

There is a convergence, as it were, of the lines of current flow from the indifferent electrode to the tiny needle electrode placed within the hair follicle; and just as from a large area the mountain streams have their source, flowing gradually one into another, until finally they terminate in a deep, narrow river, such as rushes through mountain canons, so with the current flow from the large square inch area of the indifferent electrode to the tiny surface of the active electrode. At the latter the cathions are concentrated; at the former the anions are distributed over its surface.

At the site of the internal electrode there is current density; at the indifferent electrode, current distribution.

The same conditions exist in any intra-uterine or intra-nasal application.

In the destruction of a growth, as a fibroid tumor or a mole, current density is necessary at the site of the intra-uterine electrode or of the needle in the mole.

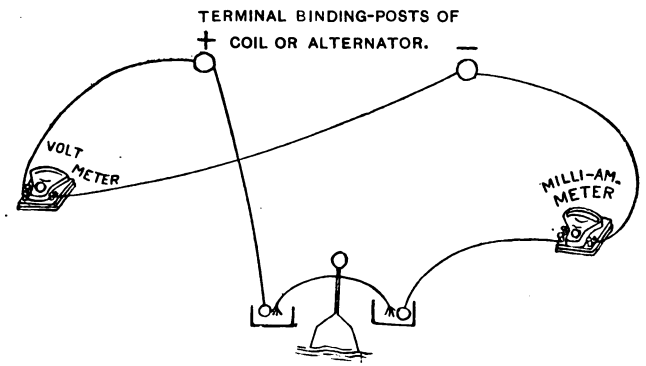
Whether current distribution or current density is required at the active electrode, depends upon the pathology underlying the condition you wish to treat.

These are factors which must enter into every application, and they are dependent upon and influenced by the resistance in the path of the current.

I have not thought it best at this time to draw any deductions from the resistances obtained in the various pathological conditions or in the different applications of the current embodied in the accompanying charts. Under the head of "Remarks" will be found statements as to the difference in resistance in the hydro-electric applications to the mucous cavities and intra-uterine applications. In the former instance the cavity is filled with warm salt water, a good electrolyte with comparatively low resistance, and more than that, the current, as we have seen, finds the way of least resistance. In the intra-uterine applications, however, the path is through the denser structure of the uterus itself, which must of necessity have greater resistance ; and in addition, these applications are nearly all of metallic electrolysis, where the formation of the oxid and its transference increases the resistance of the conducting circuit. In the cupric and zinc punctures to the cervix in a series of cases, a difference in resistance will be noted between those made into the cystic portions of the cervix and those made in the denser portions, especially in the cases of cervical fibroids. A difference will also be noted in the resistance of the conducting path in vaginal hydro-electric and intestinal hydro-electric douches, while considerable increase may be noted in the percutaneous applications over those with one mucous membrane contact. The comparisons must be made in those instances where the available potential difference or working E.M.F. was practically the same. A high pressure was used in some instances where its use is considered undesirable, and where with the present means at command of limiting the source at the terminals, it would not again be used in similar conditions.

In a few of the charts the observer has failed to record the source at the terminals. These observations were made at my clinic, where it was necessary to depend upon students for recording observed facts, and for some reason it seemed of less moment to them to record the initial pressure than the available potential difference or E.M.F. I have thought it best to submit these charts, however, as a wider range of pathological condition is thus covered.

Before concluding this paper it is with the greatest pleasure I call your attention to the chart which I now pass about, and which gives in recognized units of measurements the same facts for alternating currents of both the symmetrical and dissymetrical types, or the sinusoidal, and Faradic as for the direct currents. They are few in number, as the volt and milli-ampere meters were put in my hands but a week since. But few as they are, they have to me been very instructive, and through the agency of such instruments of precision, the therapeutic applications of these currents will soon be reduced to the same exactitude as those of the direct current.



The above diagram represents the manner of connecting these instruments both with the coil and the alternator. In these observations the readings are given in *virtual or effective* milli-amperes, and also the working E.M.F. in volts employed in sending this current through the body. From the pressure in volts and the current flow in m.a. thus obtained and time observed, calculations have been made giving the resistance, the rate of expended energy in watts and the amount of energy expended in joules. Under the head of "Remarks" will be found a statement giving the equivalent as to coil, character of interruptions and number of turns of wire with Faradic, and the frequency of the sinusoidal.

These instruments have not been in my hands a sufficient length of time to make any extended observations. A series of such

observations will be forthcoming, however, at no distant date. Personally, I feel that this addition to our equipment marks a new era and one that cannot fail to be fruitful in scientific results.

The charts accompanying this paper represent a considerable expenditure of time and strength ; but if they convey to the members of this Association a fraction of the useful and practical knowledge which they have brought the writer of this paper, she will feel that that expenditure has been wisely made. Not until work was done in the manner indicated by these charts did there come the clear and definite conception of its nature now possessed. Instruments of precision have done much towards the establishment of scientific methods, and by carrying on the work in the lines indicated very much more will be accomplished. I would therefore most earnestly recommend the use of volt and milliampere meters, and the watch or clock with both the direct and alternating currents, in daily work. Data will thus be accumulated which cannot fail to be of value to the profession and the cause of electro-therapeutics will be advanced along scientific lines.

(Tables appended at end of book.)

DISCUSSION.

Dr. C. R. Dickson, of Toronto, Ont., said that he thought the author of the paper deserved the sincere thanks of the Association. It was seldom that a paper was presented which went into the facts so carefully and minutely. These facts were presented in such a form that the paper could be read and re-read after it had been published. The tables were of great value.

Dr. R. J. Nunn, of Savannah, Ga., said he would heartily endorse all that Dr. Dickson had said concerning the paper, and had much pleasure in seconding a vote of thanks to the author.

Carried.

Molecular Effects of Electricity.

By A. E. Dolbear, A.M., Ph.D., of Tufts College, Massachusetts.

The variety of phenomena attributed to electricity and the varied purposes to which it is put in a commercial way serve to give one the idea of a mysterious agency, utterly unlike any of the others which we employ: gravity, heat, and the rest. There are many persons who are expecting more and stranger phenomena to be discovered than any we now know, and who are ready to believe the most absurd things if there be a hint of electricity about them. The only cure for such a state of mind is knowledge. But the expectant ones are not seekers after knowledge; they are after some new sensation, and they therefore doubt when they are told that the laws of electrical phenomena and the relations of electrical phenomena are so well known and have been studied in such a multitude of places that one may be sure that nothing remains to be discovered which can materially modify what we now know about electricity. It is a quantitative science, and has been pursued to the ten-millionth decimal place. Volts, amperes, ohms and farads are as definite as are pounds, feet and seconds. I do not think of a single fundamental principle or qualitative relation that has been discovered during the last fifteen years. What have been called new have been some change rung upon the old and well-known principles.

That a current of electricity would disturb the position of a magnetic needle; around a piece of iron would make the latter magnetic, or that it would induce another current in an adjacent wire; would decompose liquids, or make the conductor hot—such were real discoveries of a fundamental sort. Of course, at first the phenomena were qualitative, *i.e.*, they indicated the kind of changes that would take place under certain known conditions. Presently the knowledge thus acquired began to assume quantitative relations, and one could foresee how much change of a given kind would result from the known antecedents. Thus Davy discovered that a current of electricity would decompose liquids, and Faraday afterwards discovered that the amount of

chemical action was proportional to the strength of the current, and then either of these factors could be used to measure the other. This is precisely what is implied when we say that a current of an ampere will in one hour decompose 15.4 grains of water, setting free .7 of a grain of hydrogen, or deposit 91.8 grains of silver, and so on.

In like manner, having found that a current will heat a conductor, experiment showed that the heating power varied as the square of the current. If a given current in one minute would heat a conductor ten degrees, twice the current would heat the same conductor forty degrees, and so on, Thus it is in any other case: the electrical relations are not only qualitative, but they are quantitative, and the quantitative relations are as inviolable as is the multiplication table.

In all of the commercial industries where electricity is employed, the dynamos, circuits, lamps, motors, or whatever other devices are employed, every one is adapted to its work beforehand through the knowledge of the electrical and mechanical laws and relations possessed by the designers of the machines. I have used the word laws here, and I think it well to add that a physical law, whether in the domain of mechanics, heat or electricity, is irrefragible. There is no such thing as breaking a law of that kind. One may sometimes hear about breaking or overcoming physical laws, as when one says of the rising of a balloon that it overcomes the law of gravity. It does no such thing. The law says nothing whatever as to whether a body shall move up or down or not at all. It states that the strength of the gravitative pull between the bodies varies with their distance apart. A law is the epitome of uniform experience. If experience appears to be not uniform, then is there misinterpretation somewhere, otherwise science is impossible.

So in electrical phenomena it ought to be understood that absolute uniformity must be predicated, or there can be no science of it, or no use in comparing observations. Where the phenomena differ, the physical mechanism is different. With similar mechanism the electrical activity is uniform.

Perhaps everyone will say that so much is patent to everybody and hardly needed to be stated. Yet I have found by conversation with many that there is a lurking suspicion tolerated that under

physiological conditions the laws of electricity are not so rigidly maintained as they are in so-called inorganic nature, and that failure in practice is chargeable to electrical wantonness rather than to lack of knowledge of the precise mechanism involved.

Is it not true beyond a peradventure that all physiological processes, without any exception, are but physical and chemical processes? The standard treatises on biology and physiology say so, apparently with no misgivings. If the statement be true, then the application of electricity to physiological phenomena is but its application to physical and chemical phenomena, only more complicated than they are in a test tube, a furnace, or an electrolytic tank, and if there be no other factors to cope with, then a knowledge of the physiological mechanism, *i.e.*, the quality, the arrangement and the amount of material subjected to electrical action, will be as sufficient for successful application in physiology as it is in electroplating, and electro-therapeutics will practically be a department of electro-chemistry as it is already in theory.

The experimental study of electrical phenomena by a multitude of persons for so many years has provided us with an extensive body of knowledge of how matter in its various forms is affected by electricity. We know its mechanical, thermal, chemical, magnetic and inductive actions and relations as completely as the astronomer knows the distances, sizes, movements of the heavenly bodies; so well, indeed, that one may be as sure there is no outstanding fact which can seriously modify our present knowledge, as is the astronomer that no other agency than those he now concerns himself with has anything to do with astronomical phenomena.

How, then, does electricity modify the conditions of matter? Let me prefix the answer to this by pointing out that all the common phenomena called physical which we see in bulk are due to the inherent qualities of the atoms. Thus, the earth does not attract a stone as a whole body, but rather every particle belonging to the stone is attracted by every particle in the earth, and the stone falls as a body because the particles cohere. In like manner, electrical phenomena of all kinds are due to activities of atoms. Even in the fifty-ton dynamo the current is due to

the atomic rotations in the armature. The rotation we see and count as so many per minute, is only the mechanical antecedent we employ to secure atomic rotations which are produced by the magnetic field in which the armature moves; and all so-called mass motions which result from electrical actions are but the resultants of the motions of atoms of which the body moves. It may be noted that I use the word atoms and not molecules, which is the more common word for such ultimate parts. Molecules are but atoms combined in varying degrees of complexity and number, from a simple one of two atoms, like HCl, to one of twenty or thirty thousand, like protein; and the properties of molecules are but the algebraic properties of their atomic constituents—that is to say, chemical combination does not develop new properties, but each different combination sums up the intrinsic properties in a different way. If this were not so, the properties of bodies would vary as their masses, which is not true.

A clear perception that there is no essential difference between the motions of large and small bodies will be helpful here. We call the translatory motion of a body a mechanical motion when it chances to be a body which may be seen like a projected bullet or a shooting star; but when a molecule too minute to be seen has a similar translatory motion, it is common to speak of it as *free path* or molecular motion. In like manner, we call the to-and-fro movements of the parts of a sounding body *vibratory*, while the similar motion of an atom or molecule we call heat, and so heat phenomena have come to be thought of as in some way radically different from the kinds we can see displayed in larger bodies. The antecedents of sound we know; usually they are some kind of mechanical motion like impact or friction. If the impact or friction be too severe, a rupture or disintegration of the sounding body follows, for the energy imparted exceeds the cohesive limits.

When an electric spark passes between two electrodes, some of the surface molecules of the anode are torn off and are driven to the kathode with great speed. A spark from silver into hydro-chloric acid will make a white spot upon the latter, for silver chloride is formed. A spark from iron will make a blue spot in a solution of potassium ferrocyanide. These molecules leave the electrode with a velocity exceeding a mile in a second, but the viscosity of the air

quickly slows them to a small fraction of that. Sores may be produced upon the skin by metallic hail from copper, brass or other terminals. Possibly some skin diseases might be cured by some appropriate metal spray applied in this way. It would seem likely that the molecular impact would disrupt the molecular surface structure, and the outcome be different from what it would be if contact and chemical action alone were depended upon.

A current of electricity always heats the conductor through which it passes. It makes its atoms vibrate, and if the current be increased the temperature rises, that is, the amplitude of vibration is increased, and when it reaches a certain degree the molecules can no longer cohere and fusion or dissipation takes place, a process as purely mechanical as it is in the case of too vigorously shaking the sounding structure. If now we say that electricity destroyed the cohesion it would not be true. It is the heat that has destroyed the cohesion. The electrical energy must be first transformed into heat energy before it can thus affect a body.

If a still stronger current is sent through a fused conductor the temperature will rise higher until the substance of the conductor is vaporized and its molecules are gaseous particles, quite the same as if heat were applied in any other way. *The current is only a convenient device for supplying heat.* The phenomena are simply the phenomena of heat, and it is an error to speak of them as electrical phenomena.

Some substances do not fuse on being heated but become gaseous directly from the solid state. Such are wood, charcoal and the hard carbons in general. In an arc lamp the current heats the carbon tips to a white heat because the energy there is all spent upon a very small amount of matter, nearly a horse-power on an area about the eighth of an inch square, but the carbon shines because it is heated, not because electricity is there. *The electric current is only a convenient means for producing a high temperature.* The same is true in the incandescent lamp, only the temperature is kept below the disintegrating point.

In the common arc lamp the carbon rods slowly burn away, for hot carbon will combine with the oxygen of the air and escape as carbonic acid gas. If excluded from the air, this chemical action cannot go on and the rods are much more enduring, yet the

temperature is so high that the surface molecules of the carbon are evaporated very much as water is evaporated. This action shows itself by blackening the interior of the containing globes. On escaping from the hot surface the gaseous velocity is very great, probably several miles a second, and the hot carbon becomes imbedded in the glass. In the incandescent lamps, when the vacuum is good this action soon shows itself by the blackening, and one may often see that each part of the filament shields its side from the bombardment of the other side. Wherever there is high temperature this same action takes place on account of the nature of heat. *Electricity as such has nothing to do with it.*

When the terminals are separated as in a Crooke's tube and electrical charges from an inductive coil or other suitable source are led to the terminals, the interior of the tube is lighted by the phosphorence of the residual gas molecules. At all times these molecules are bounding back and forth, bumping against each other and the sides of the tube, but when they strike upon the terminals they strike upon surfaces that are heated, and therefore rebound with greater speed and not unfrequently the flying molecules are quite disrupted. They shine for the same reason that a spark in air shines —or a flash of lightning. The same phenomena have been observed in tubes whose terminals have been heated in other ways. It is a phenomenon of heat rather than of electricity. *The electric current is only a convenient means of getting a proper degree of heat to such interior surfaces.*

It is not the electricity we see, nor the effect of electricity, but the *effect* of *heat*. The increase in vibratory rates results from antecedent molecular agitations.

Again: An electric current through a solution results in decomposing it. If it be water the oxygen appears at the anode or where the current enters the solution, while the hydrogen appears at the kathode. This happens no matter how wide apart the terminals may be. If the water have chemical substances dissolved in it, like salt or copper sulphate or potassium nitrate, the sodium, the copper, or the potassium will be set free from their associates at the kathode while the associates will appear at the anode, and between them there will be no apparent decomposition. This was for many years a puzzle, but it is now believed to be unravelled in a

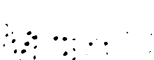
satisfactory manner. When a solid is dissolved in water it is not only broken up into its molecules, which are individually scattered in the liquid and behave like gaseous particles, but the molecules themselves lose in great measure their chemical cohesion and are continually changing partners. These exchangeable partners are called *ions*. An electric current through such a body of dissolved molecules does not itself decompose them, but polarizes and directs them. This sodium atom which has just been dissociated from the chlorine atom on the left, will next combine with the chlorine atom on the right, to be in turn rotated and displaced at the left. By polarizing them is meant that each molecule is oriented so all face one way, for reasons similar to that which causes magnetic needles to set their similar sides at right angles to an electric current. In a liquid there is no molecular resistance to rotation, so the slightest solicitation is sufficient to arrange in military order a vast number of molecules. A body of soldiers might stand still for a time after being thus polarized, but molecules possess individual activity in the shape of temperature which causes them to be continually disturbed in position; but in the field of an electric current, though the disturbance continues, the angular displacement is greatly reduced and readjustment goes on continuously. But the activities I have described are such as belong properly to the science of thermodynamics. They are chemical and thermal. The amount of chemical decomposition is strictly proportional to the thermal energy involved, and that in turn to the electrical energy spent. *The electric current is a convenient agency for directing chemical work.* It is selective of such as independently take place. One may say that what are generally called electro-chemical actions are due to electro-magnetic properties of the current, for atoms are more sensitive to magnetic fields than molecular structure in general. It may be remembered that chemical combinations cannot take place in the absence of heat, and that electrical conductivity increases as the temperature falls. Stated in another way, atomic vibrations are essential for chemical phenomena but are not for electrical.

The gradual movement of the electrical ions towards their proper electrodes can be witnessed in many cases by the change in color of the solution, as, for instance, in copper solution, while the

copper is being deposited upon the kathode; but the same thing may be witnessed on sending a current through a glass tube containing a solution having visible particles like starch grains suspended in it, and a globule of mercury will slowly crawl along towards the kathode. It is the prevailing opinion that such movement is not so much due to an electric push as it is to chemical tension.

What is called electrical osmosis shows itself when a current is sent through a porous diaphragm like a porous jar to a galvanic battery. The liquid piles up about the negative element to a height which depends upon the circumference of the jar—the greater the circumference the greater the difference in level between the inner and outer liquids in the cell.

From these examples one may fairly infer that the direct action of electrical currents is neither mechanical nor chemical, in the ordinary sense, but is thermal, and that the various reactions we note are the results of the latter. But there are other effects as important as either of these, which are commonly known as *inductive*. The term implies a non-conductor, and therefore the absence of a current, and a perfect vacuum gives the most complete inductive condition. An electrified body, or an electrical current in a conductor surrounded by a vacuum or non-conductor, reacts upon the medium which we call the ether, and produces what we call an electric or electro-magnetic field. This field consists of a stress or a warp in the ether of such a nature as is capable of changing the positions of atoms, molecules, and through them of visible masses which may chance to be in the field. The behavior of a magnetic needle in such a field, and the current of electricity set up in a neighboring conductor, illustrates this inductive ether action. The nearer the electric body is to an adjacent body without quite touching it, the stronger is the inductive reaction between them for purely geometric reasons. The strength of the field varies inversely as the square of the distance from the body that incites it, like other radiations; but the presence of the body upon which it can act, immediately modifies the distribution of the stress. The effect of this stress upon a neighboring body is to produce electrification upon it the opposite in quality from that of the body that produced the stress, which is exactly reversed when the bodies touch and conduction takes place. An important thing to be



considered is that it is quite impossible to prevent this inductive action, seeing that every atom is bathed and is swimming in the ether ocean, and its electric condition is at once communicated to it in the way of a stress, and as this ether stress is distributed in space at the rate of 186,000 miles a second, a rate enormously greater than any mechanical action between particles can take place, it follows that even in what we call conduction the inductive action must precede conduction, the latter going on no faster than the atoms can adjust themselves to the travelling ether stress.

One may easily imagine what goes on when electric action, either inductive or conductive, is taking place. Imagine a linear series of small magnets, very near each other but not quite touching, and each one free to turn on some axis. Their relative position would be determined by their own small fields, and some would be found pointing in all directions. Let a strong magnetic field be suddenly set up at one end of the line, and it will start to travel out at its normal rate in every direction, but the magnets of the series will each one respond to the field, and endeavor, so far as they can, to adjust themselves to it, the nearer ones first and the more remote the last. As it takes time to move even a particle, it follows that the field will have travelled a long way before the remote ones will have moved appreciably. The magnets themselves will have changed their positions by rotating each on its axis, and this travelling line of rotating magnets would constitute what we call the current in a conductor. Outside of it would be the travelling field capable of acting upon other bodies, as well as the particular ones in the linear series we imagined, which process is called inductive action, or simply induction. For this reason inductive action shows itself on the surface of bodies, for the source of the disturbance is outside of the body which exhibits it.

If a perfect vacuum surrounds the conductor, these two processes will go on with no complications. If there be no more or less poorly conductive material surrounding the conductor, like air, water, or so-called insulators, the latter will be a hindrance to the process, for it will be influenced first by the field from the source, and next by the changing field, due to the changing positions of the atoms of the conductor. As there is no kind of matter, solid, liquid or gaseous, but what has some degree of

conductivity, it follows that a complete account of what we call electric current is a complicated phenomenon.

There is still another complication, when a current is turned into a large conductor like the earth. The current at first spreads in every direction, due to simple conductivity and the presence of electric pressure. Suppose the terminals of a telegraph line be one thousand miles apart, with the earth as a part of the circuit. On closing the circuit at one end, the current will rush into the earth, with no guide for direction. Directly it will rush into the earth at the other end of the line, but with opposite polarity, and spread undirected as before until the two spreading sheets meet, when the lines will begin to close up and the current will assume a uniform distribution, densest in the line of best conduction between the earth terminals but even there it will actually be spread out enormously in the earth, and the diameter of its flow may be two or three thousand miles.

In like manner will a current go through any conductor. Send a current through the human body, say. from head to foot, and every molecule in the body will be affected in some degree. Even the fingers of the opposite hand are bound to be affected, because the inductive action of the current through the body will affect all bodies outside it, and a magnetic needle at your side will change its position. I am not speaking of amount of change, but only saying that every molecule, and consequently every cell, in the body must be affected in some degree. And how affected? In the line of the current the better conducting parts will have their atoms changed in position by solicitation of the field as in a solid conductor, and also where there are non-conductors of any degree their conductive action will tend to invert the direction of action present in the former case. If the disturbance be not great enough to bring about thermal changes of magnitude sufficient to determine chemical changes, nothing perhaps would follow, but it is known that the more highly organized molecules of matter are less stable than the lower organized—nervous tissue than muscle or tendon. Fatty tissue is poorly conductive, yet nerves and blood vessels running through it might be affected, whether for good or ill depending on whether the chemical action resulting was in line of the normal activity or otherwise, a

matter to be determined wholly by experiment. No, *a priori* the judgment is worth anything here. Still, if it be granted that chemistry and physics within and without the body are precisely the same, and that there is no new agency to reckon with, one must always think along on chemical and physical lines, and no other.

One cannot direct an electric current in the body as he can in a wire. Where the densest part of the current will flow will depend on local conditions, the presence or absence of proper conducting material, and the geometric direct way might not be the electric way, and one might get to the heart better through, say, an arm or the neck than through the back. Almost everything now known about electro-magnetism seems to imply that a magnetic field, whether produced by a permanent magnet or by a current, reacts in some measure upon all kinds of matter within the field, and in such a manner as to rotate in some degree every molecule, so as to make it assume a different position from what it would assume if not thus acted on. If chemical action be taking place in that field, more energy must be spent then for a given product. In the process of digestion, the molecular structure is apparently quite broken down in its atomic constituents, which are again recombined into radically different compounds. An electric current or a magnetic field ought to make a difference, both in the rate of reorganization and the product. Just what it would be might be difficult to make out, on account of the complexity of the process. In respiration I should expect this effect could be detected. I should also expect oxidation would take place at a more rapid rate in a quiet magnetic field, for it is now certain that oxygen displaces nitrogen to an appreciable extent near the poles of a magnet. In such case the magnetic field should act as a stimulant.

If the magnetic field were an alternating one, there would be still more energy spent—not that it would do chemical work itself, but would accentuate it.

If physiological actions are chemical, then disordered function is indicative of inappropriate chemistry. Electricity we know is entirely capable of directing chemical action, and more, is in all probability always to be reckoned with as an agency present in all

chemical action. Whether in its application as a remedial agent it should be used directly as current—constant, periodic, alternating—or inductively in static or electro-magnetic form, with high or low pressure, these are physico-physiological questions to be settled by experiment.

DISCUSSION.

Dr. G. B. MASSEY, of Philadelphia, Pa., said that personally he had been especially impressed with the presentation of the subject of the molecular effects of electricity. In our ideas of electro-therapeutics we had to combat the notion of the older neurologists, who looked upon electricity only as a nerve stimulant. It was also necessary to enlarge the notions of more recent workers, who considered only a special polar effect in the immediate neighborhood of the poles. We must now consider the effects at a distance from the poles in the human body. At the present time electro-therapeutics was applied to diseases hitherto treated only by internal medication. By internal medication was meant the application to the mouth of agents intended to act only on certain portions of the body. Such a method had the manifest disadvantage of requiring that the whole system should be flooded with the remedy. This was well illustrated in the use of corrosive sublimate or of calomel internally in the treatment of cases of iritis. Electrical treatment opened up a vast field for the saturation of *individual* parts of the body, provided, of course, that the operators had first carefully mastered the underlying physical principles. Individual life, tissue action and cell growth, he said, were all attended by electrical action—a point that had been dwelt upon in the paper under discussion. Disturbed vital and chemical actions in the body were, of course, accompanied by disturbed electrical conditions. This had been alluded to some years ago by Dr. W. J. Morton. The possibility of applying to that portion of the body, from the exterior, an artificially generated electrical action was an exceedingly interesting and important one. We were thus enabled to control aberrant, cellular and nervous action.

Dr. CALEB BROWN, of Sac City, Iowa, said that he thought

Professor Dolbear had struck the keynote of electro-therapeutics when he began talking about atoms and molecules. As physicians we knew of the subject of physiological chemistry, and the chemical processes in the body were matters of which we were comparatively ignorant. We knew that more and more complex molecules were formed in the body as the result of digestion and absorption of food—indeed, that this process took place in all the physiological processes of the body—and that, as a result, there were developed a vast series of poisonings and auto-intoxications, but the whole subject was still very little understood. He thought electro-therapeutics was destined to throw much light on this subject, and particularly to afford much ground for encouragement in the department of therapeutics.

Dr. G. B. MASSEY, of Philadelphia, Pa., moved a vote of thanks to Professor Dolbear for his highly instructive paper.

Dr. R. NEWMAN, of New York, in seconding the motion, said that we should also bear in mind the great amount of work done by Professor Dolbear last year in the Committee of Arrangements. The motion was carried by a rising vote, the Association standing to emphasize its appreciation of the work of Professor Dolbear in its behalf.

The Influence of Magnetic Stress on Physiological Action.

By W. J. Herdman, M.D., LL.D., Ann Arbor, Mich.

It is needless to enter into any preamble, argument or exposition further than is contained in the excellent paper to which we have just listened,* to convince us that there exists the possibility of a relationship between magnetic energy and physiological or life processes which is deserving of careful investigation, and reasonable hopes can be entertained that from such explorations much will be discovered that will be useful in therapeutics. The interdependent and interchangeable relations of magnetic and electric energy are already well known. The interchangeableness of electric and physiological energies are likewise readily demonstrable.

Radiant energy, mechanical energy, chemical energy, each have their physiological equivalent, and it is wholly unwarranted to assume that magnetic energy alone sustains no relationship to, or has no influential disturbing action upon, the molecules and atoms that make up a living animal or vegetable organism. The opinion has long been entertained by many that magnetism has its part to play in these life processes, and some few efforts have been made in the line of direct experimentation by experienced and competent men to discover, if possible, some facts which would justify this opinion. Notable among these are the experiments reported by Kennelly and Peterson at the New York meeting of this Association in 1892.

They consisted in one series, as some of you will remember, of observations as to the behavior of a drop of water, pulverized iron (iron by hydrogen), powdered hæmoglobin, living ciliated epithelium, and the circulation of blood as shown in a frog-foot preparation placed on a microscope stage and inserted between the poles of a powerful electro-magnet. The drop of water was seen to change its shape in the magnetic field, and the finely divided iron acted in the same manner as iron filings, but the results upon the others were negative.

*Prof. Dolbear's, on "Molecular Physics."

A second series of experiments sought to determine the effects, if any, upon motor nerve conductivity by enclosing a small dog for some hours in a strong magnetic field. This experiment appears to me to be incomplete, and therefore valueless.

A third series had in view to determine the effects upon either sensation, motion or other physiological action by inserting the head of the subject for an indefinite, but presumably brief period into the field of a strong electro-magnet through which the exciting current was made and broken without the knowledge of the subject of the experiment. The subject's statement was taken as to his state of consciousness during the test, and sphygmographic tracings were made of the pulse at the wrist, and the rapidity of respirations were noted. These experiments likewise resulted negatively.

A final series was made with the view of testing the effect of a rapid reversal of the magnetic field by using a great number of turns of copper wire in the form of a coil, of sufficient diameter to admit of the head of the subject being inserted into the interior, and so subject the brain to the alternating magnetic field for a length of time not stated, presumably only a few minutes.

The authors of this valuable paper conclude their account of these various experiments with the following statement: "The human organism is in nowise apparently affected by the most powerful magnets known to modern science. Neither direct nor reversed magnetism exerts any perceptible influence upon the iron contained in the blood, upon the circulation, upon ciliary or protoplasmic movements, upon sensory or motor nerves, or upon the brain."

It is true that the results obtained by them were for the most part negative, and we cannot deny that their experiments were carefully devised and faithfully carried out. But these negative results were themselves positive facts which serve, to that extent, to mark the limitations in this special field of science. The first chippings from the marble block may not reveal the statue that lies concealed within, and yet when the blows are intelligently and skillfully directed they are making positive progress toward that end.

I think it will be seen, upon careful scrutiny, that the claims

made in the conclusions drawn from these experiments by their authors are, however, entirely too broad, and that the means which they employed for detecting possible changes in the physiological mechanism are wholly inadequate.

It may be true that the most powerful magnetic flux that man can devise is incapable of producing changes in certain substances, such as hæmoglobin, so that such change will be revealed to the eye on the stage of a microscope, and it may be likewise true that neither varying unidirectional nor alternating magnetic fluxes may cause such changes in the brain action, at least in a brief period of time, as will visibly disturb its functions ; and yet, in spite of this, such molecular action as is going on in living cells may be, and in all probability is, modified by variations in the degree and direction of the magnetic stress to which such molecules are subjected, and that it will only need patience and shrewd guessing as to where to look for the results of such action in order to detect it.

Permit me here to make a brief quotation from a recent work* of Professor Dolbear :

"It is customary to think of iron as being peculiarly endowed with magnetic quality, but all kinds of matter possess it in some degree. Wood, stone, paper, oats, sulphur, and all the rest, are attracted by a magnet, and will stick to it if the magnet be a strong one. Whether a piece of iron itself exhibits the property depends upon its temperature ; for near 700 degrees it becomes as magnetically indifferent as a piece of copper at ordinary temperature. Oxygen, too, at 200 degrees, adheres to a magnet like iron.

"In this, as in so many other particulars, the manner in which a piece of matter behaves depends upon its temperature ; not that the essential qualities are modified in any degree, but temperature interferes with atomic arrangement and aggregation, and so disguises their phenomena. As every kind of matter is thus affected by a magnet, the manifestations differing but in degree, it follows that all kinds of atoms, all the elements, are magnetic. This is an inherent property in them, as much so as gravitation or inertia, a quality apparently depending upon the structure of the atoms

* "Modes of Motion," by A. E. Dolbear. Boston: Lee & Shepard. 1897.

themselves in the same sense as gravitation is thus dependent, as it is not a quality of the ether. An atom, then, must be thought of as having polarity, different qualities on the two sides, and possessing a magnetic field as extensive as space itself."

If this is the true conception of every atom in its relation to magnetism, no matter into what combinations it enters, we cannot arbitrarily divorce the atoms of matter which enter into living vegetable and animal cells from such magnetic attributes, any more than we can such atoms when they are present in non-living substances, and such anatomical magnets would be subject, according to their nature, to the influences of varying magnetic stress, no matter into what combinations they had entered. But the results of such stress upon them would, of course, be modified by the other forces operating upon them at the time and in the situation where they are placed, and what those results are can only be determined by observation and experiment. It is scarcely to be expected that they would be apparent to the naked eye, or if molecular, that any power of the microscope would reveal them. Seeing, also, that every organism on the face of the earth has, from the beginning of its existence, been bathed in and permeated by magnetic flux due to the earth's magnetism, and that in all probability the number of lines of magnetic force that traverse the body of a person, from this source, are seldom constant, such influences as the earth's magnetism exerts are so much a part of the constant existence of the organism, and so continually operating that they are no more likely, but even less likely, to be the subject of conscious perception than is the oxidation of the blood or any other of the tissue processes that are continually going on in our bodies, but of which we are unconscious.

A marked variation, however, in influences that are constantly operating upon the organism may be presumed to exhibit in time, longer or shorter, some modification in the action of that organism. Thus we note the influence of change of climate upon the growth of both plants and animals, where the variable factors are those of degrees of moisture, atmospheric pressure, heat and sunlight, all of which are in operation continually in all places on the face of the earth, but vary in proportion in different localities, and so cause the results depending on them to vary correspondingly.

Just as the variation in one or other of these factors, which enters into what we designate as climate, affects the physiological activities of animals and plants, so, it appears to me, might we expect some changes to be brought about by artificial variation in the magnetic field, provided such change is strong enough and is continued long enough to show some result.

With this idea I began, a little more than two years ago, a series of experiments at the Electro-Therapeutic Laboratory of the University of Michigan, upon man and growing animals by subjecting them for a considerable length of time to the influence of alternating magnetic fields.

This was done by constructing a solenoid of No. 10 underwriter's wire, three feet in diameter and six feet in length, and with a sufficient number of turns of wire so that a current strength of five amperes produced an average of forty C. G. S. lines for each square centimeter of space in a plane cross-secting the space within the coil. But for convenience and also to determine the value of what we already have at hand, I used the current from a Thompson & Houston alternating dynamo, employed for electric lighting, to excite the coil, or solenoid. This dynamo made sixty-two cycles per second, or 124 alternations. So that the magnetic field or stress in the space enclosed by the coil changed its polarity with this frequency. Whatever occupied this space within the coil or solenoid, therefore, was subjected to this varying magnetic stress.

The first series of experiments was made with the view of determining the influence of this magnetic field on the metabolism of tissue as determined by the output of urea. Three subjects were chosen, two of them healthy young men, students of medicine, and the other a man of thirty-eight years of age, who had for two years been suffering from paralysis agitans, but who, aside from his nervous affection, was in fair health. The diet was regulated in amount and variety in each case for a week previous to subjecting them to the magnetic action, and a daily estimate made of the amount of urea excreted. Then for a week's time, without change of diet or manner of living in any other respect, each one of the three subjects was placed within the solenoid, comfortably outstretched upon a platform, and allowed to remain

there for two hours each day, their bodies pervaded by the alternating magnetic stress of the average strength above mentioned. During this week also a daily estimate of the quantity of urea was made, and it was found that in all three cases there was a daily increase of about 10 per cent. in the amount eliminated during the period in which the subject was in the magnetic field, as compared with the previous week. No other effects were noticed that could be detected by our method of observation. There was no apparent change in the depth or frequency of respirations, nor in the strength or frequency of the pulse or arterial tension, though it is possible that had more delicate or exact methods of testing for such changes than the unaided eye and touch been employed, some difference in these functions would have been observed. The subjects were conscious of no change in sensation or motor power, except that the patient with paralysis agitans claimed that the period spent within the coil had a soothing and quieting effect upon him, and that the muscular tremor which attended his disease was for several hours after each exposure much less violent.

The next series of experiments was with growing animals to determine the effect, if any, of the alternating magnetic stress in retarding or accelerating their growth. Experiments of this nature I have carried on at my laboratory almost continuously for the past two years. Some of the time the animals used were rabbits, and at other times guinea-pigs. As soon as one or more litters of young rabbits or guinea-pigs were old enough to be separated from their mothers, they were divided into two groups as nearly alike in age and weight as possible, and carefully weighed. The two groups were placed in conditions of living in all respects similar, except that from five o'clock in the evening until midnight, one group was placed in a cage made of the above-mentioned coil of wire through which the alternating five ampere current, with the frequency of alternations above mentioned, was passing, and the other group was placed in an exactly similar coil which was not connected with the current circuit. This plan was pursued with each group of animals selected until they had reached their full growth, or from six to twelve weeks, according to the age of the animals at the commencement of the experiment. I have the weekly record of the weight of each of the groups of animals experimented upon in

this manner, and it will be published as a part of the report in my laboratory bulletin, but it is not necessary to burden this paper with the details. The interesting conclusion that has been reached so far from these experiments, which are still in progress, is that, without exception, the group of animals that is immersed in the alternating magnetic field begins, after the first week, to outstrip the other group in weight, and that a gain of from eighteen to twenty-four per cent. in favor of the animals within the magnetic field is observed each succeeding week until they near the period of full development, at which time the weekly gain is less. During the two years in which these experiments have been going on, ten separate groups of animals have been used either in the field or as controls, each group containing from three to five animals, and the statement that those placed in the magnetic field gave evidence, for the first few weeks, of accelerated nutritive action is without exception. In case of two of the groups, when the experiment was continued beyond eight weeks, the curve of increase shown by the magnetized animals, which until eight weeks ran 20 per cent. higher than that of the other group, gradually declined, and at the end of the twelfth week it had fallen a little below that of the other group.

It is an interesting fact that the janitor, who has charge of these animals and who is a shrewd observer, but without knowledge as to the purpose of the experiment, called my attention to the fact that the groups of animals that were placed within the magnetic field spent much more time in sleep during the daytime than did the other group, but in no other respect, except the increase in weight, did he or I notice any difference in the appearance or conduct of the animals.

As far as these experiments go they appear to show that alternating magnetic stress is in some way related to a quickened metabolism of tissue; that magnetic energy goes through some transformation and appears as physiological energy.

These results are very similar to those reported by D'Arsonval and others as resulting from what he has termed *auto-conduction* brought about by high-tension, high-frequency currents; and as the apparatus employed by D'Arsonval is not unlike that which I have employed in my experiments, although I did not see any

description of D'Arsonval's experiments until some months after I begun those I have been describing, it is not improbable the effects we have observed are due to a similar action. There is this difference to be noted, however, that while the currents employed by D'Arsonval were of the high-potential, high-frequency character, where the voltage and alternations reached hundreds of thousands, the current employed by me was of only 52 volt pressure and the frequency of alternations but 124 per second.

The New Electro-Mercuric Treatment of Cancer.

By G. Betton Massey, M.D., Philadelphia, Pa.

Having read a paper on this subject at the recent meeting of the American Medical Association, at Philadelphia, in which I called the attention of the medical profession to the cataphoric diffusion of mercury in massive doses as a reliable and practical method of eradicating cancerous growths,* I shall only occupy your time by presenting some general facts concerning the method, and with a statement of its technical details and results, so far as developed by me.

In a limited series of cases in which accessible and still presumedly local sarcomas and carcinomas have been experimentally subjected to this method, I have had two well-proven cures and four or five cases now progressing towards the same happy result. Some of these cases date back to 1893, when I accidentally noted the good effect of a mercurial coating on a zinc anode in contact with a cancerous ulceration, and began the treatment with doses of 100 and 150 milliamperes under cocaine cataphoresis, but my own estimate of the value of the method received an immense impetus during the past spring on the occasion of the first employment of mercury with 500 and 1000 milliamperes to a carcinoma of the breast, under general anæsthesia. The usual effect of a local necrosis about the zinc-mercury electrodes occurred, the tumor shrank perceptibly at once from a cataphoric dispersion of its liquid contents, but a most important fact was noted the following day when the dry dressing was removed. It was then seen that the puffed, purplish, malignant appearances had disappeared beyond the area of necrosis, the skin and subcutaneous tissue now lying flat and pink to a considerable distance from the electrode. This proved that *a substance or influence had passed from this amalgamated electrode through the malignant tissue that had had a lethal effect on the cancer cells, while failing to hurt the connective tissue containing them.*

* *Medical Record*, July 31st, 1897.

The key to the results in all the cases was contained in this single observation, and I venture to predict that few, if any, discoveries in medicine have surpassed it in practical importance, for it not only gives conclusive proof of the correctness of present pathologic views which regard cancer cells as primarily local and possessed of a low vitality in spite of their virulent prolificness, but, far more important still, indicates a remedy for accessible cases of this scourge of mankind.

The special value of a method by which the most powerful antiseptic known may be made to traverse a cancerous growth interstitially, in its most active, nascent form, is peculiarly evident when we consider that the method is a monopolar one and that the mercury-laden current while in transit to the negative pads may follow the cancerous prolongations to their utmost extent in the healthy tissue. We have also another advantage incidental to this fact. The cancerous prolongations will usually be better conductors than surrounding tissues by reason of a higher percentage of water, and will thus, to at least a slight extent, receive more lines of flow.

It would be interesting to ascertain the amount of mercury by weight that can be carried into the growth per milli-coulomb, also the distance which it will traverse per volt-hour. I find a table in Lodge's work which gives the cataphoric speed of seven substances, of which hydrogen is the most rapid, traversing an electrolyte at the rate of 1.08 centimeter per hour per volt. Lithium is the slowest, at 0.094 centimeter per volt-hour. Taking 0.1 centimeter per volt-hour as a probable guess for mercury, it would mean that 100 volts would cause the mercury to travel 10 centimeters per hour, and less than one and a half centimeters in ten minutes. These facts have much practical importance, indicating that we must have a sufficient duration of the current to secure proper penetration, and that amperage alone, while governing the amount and density of the penetration, is incapable of increasing the extent of penetration without adding additional time. Since seeing this table of Dr. Lodge's I have been convinced that some of my applications have had an insufficient duration. The exact cataphoric speed of mercury should be determined, and it is my intention to make observations on this point at an early date.

Concerning the practical details of the process devised by me for the cure of cancer, I must premise that it consists of two methods, the gradual and the rapid method, adapted to different stages and different situations of the growth. The gradual method is simply an intensification of a method used by me daily in the cure of obstinate catarrh of the uterus, etc., in which an amalgamated zinc, copper, or gold electrode is applied to the ulcerated surface and as much mercury driven in as the pain produced will admit. This is adapted to incipient cancers of the surface, carcinoma of the cervix uteri, etc., and to very bad inoperable cases in which the rapid method is unwise.

In the rapid method the patient is thoroughly anæsthetized and two or three large indifferent pads are placed under the back and connected with the negative pole of the battery. To the positive pole a multiple connection cord is attached, which is to be connected to a dozen or less zinc electrodes when the latter have been inserted into the growth.

Openings must usually be made into the tumor for the insertion of the electrodes. [In case the tumor is very vascular all bleeding may be prevented at this moment, the only time when bleeding can occur, by making the punctures with a steel spear electrode which is employed as the negative pole. After the current has been turned on with positive electrodes in the growth all bleeding ceases.]

Eight hundred milliamperes is the greatest current so far used in this monopolar method, as this amount depressed the breathing when the right breast was being operated on. This was doubtless due to the fact that one of my dispersing pads was on the abdomen and the other on the back. Since then the dispersing pads have been arranged to avoid this difficulty.

In two cases I have hurried the local dissemination of the mercury by placing a cotton-covered disc saturated with liq. potass arsenitis on the tumor as the negative pole, cutting the dispersing pads out of the circuit. The application now being bipolar and mainly local, the current was increased to 1000 milliamperes. It will be noted that this application produced a valuable cataphoric action at each pole, mercury going in at the positive pole and freed arsenic at the negative pole. In each case the metal that is

cataphorically conveyed is first combined into a compound with the ions freed at that pole in the electrolysis of flesh.

After sufficient local effect has been produced the application is terminated and the patient put to bed. At the end of twenty-four hours a slough will show, surrounded by an area in which the cancerous manifestations have been quelled entirely or partially in accordance with the thoroughness of the application, without the sustaining tissues being necrosed. The slough is largely aseptic, and will come away in about twelve days, permitting us to determine whether a repetition of the process is necessary. The cavity left fills up readily by granulation.

NOTE.—Since reading the above paper before the Association, additional experience has dictated important improvements in the method, chief of which is the discovery that mercury can be diffused far more rapidly from amalgamated fine gold electrodes than from amalgamated zinc electrodes. The mercury disappears so rapidly from the gold instruments, in fact, that I have been compelled to devise means for supplying it in abundance during the operation. A rough test shows that about two grains will be carried in by fifty milliamperes in five minutes. A small portion of the gold is also probably diffused. It is notable that the merc-auric application is free from a tendency to produce sloughs of any extent, even with 250 milliamperes per electrode. The profound effects on the malignant qualities of the growths that are gained in spite of the lessened cauterant effect, indicate that the gold anode enables us to confine the effect to an interstitial destruction of the cancer cells alone. This makes it unnecessary to resort to bipolar currents, which have the disadvantage of producing sloughs more readily, and are wanting in the diffusion effects which carry the current into the base of the growth. The wounds produced by the gold electrodes remain in a thoroughly aseptic condition, doubtless owing to the deep penetration of the powerful antiseptic substances produced from the mercury. No constitutional effects attributable to absorption of the mercury have so far been noted.

DISCUSSION.

Dr. R. NEWMAN, of New York, said that he was sorry to rise to discuss a paper of this kind which had not been presented in full. The whole treatment of cancer was very simple in theory, but difficult in practice. All that was necessary was to destroy *every* cancer cell. By electricity we wish to do one of two things: (1) to absorb and kill the cancer cells; and (2) to destroy the tissues of the tumor. He could not see anything new in the

treatment propounded in the paper; it was practically the old treatment by cauterization and the introduction of metals. As long ago as 1877 he had had a case of sarcoma of the neck in the practice of Dr. Vosburgh, of New York. Dr. Sands had refused to operate. The speaker had used six needles in the tumor, and employed mercury and zinc at the same time. The tumor had disappeared entirely under a current of only 20 to 25 m.a. The very powerful currents he did not think were indicated. Wherever he had used very strong currents the patients had not done very well. He had learned the Inglis Parsons method from the author of the method himself. One of the latter's patients had stated to him that her whole side had become black after a treatment, and that a week or more had been necessary to recover from the treatment. The case in which he had used mercury had not been published. In 1891 the case was referred to in his paper, and in 1892 the assistant of Professor Kocher saw her in Europe. This patient certainly lived over two years, although other practitioners besides himself had agreed at the beginning that the case was desperate and well-nigh hopeless. He thought very few patients could stand 500 m.a., although he would not say that every patient would be killed by such a current. He had entirely abandoned the system of using a number of needles attached to one pole, for where there were twelve needles attached to one pole, as in Dr. Massey's apparatus, each needle only carried one-twelfth of the current. Why not, therefore, use one needle with a milder current?

Dr. F. B. Bishop, of Washington, D.C., said that he had been greatly interested in the paper, yet he had been unable to understand how Dr. Massey could expect a diffusion of mercury from the positive pole. Mercury is an electro-negative element, and is attracted by the positive pole, as is manifested in all of our acid batteries. It is driven from the negative pole, and is always attracted by the positive pole; therefore, any good effect obtained by Dr. Massey must be due to the diffusion of the zinc through the mercury.

Professor A. E. Dolbear, of Tufts College, Mass., said that matters of this kind must be settled by experiment. If mercury were found at the pole mentioned by Dr. Massey, then there must

be a change in the mechanism, as he had described this morning in his paper. Suppose, for example, the elements involved were zinc and mercury, and not mercury and some alloy or chloride, this might make all the difference in the direction which the mercury would take.

Dr. F. B. BISHOP asked if the action of the current on any salt of mercury would not have a tendency to destroy the combination, and attract the mercury to the positive pole, and the salts to the other?

Professor DOLBEAR replied that it would in some cases, but not necessarily in all. For instance, if the mercury were to act as an acid, so as to form, say, a mercurite of zinc—if there could be such a combination—then it would work.

Dr. R. J. NUNN, of Savannah, Ga., said that it was a very old idea that Donovan's solution applied externally would cure some cases of cancer. It was his belief that our ideas of cancer were entirely too general—everything is cancer. He had become strongly impressed with the idea that in this great family of cancers there were many individual peculiarities and differences which were not taken into consideration. Donovan was a contemporary and intimate friend of his father, who was also a physician. Donovan made for him a solution of extraordinary strength for the special treatment of these conditions. It was used successfully in certain cases. The speaker said that he had himself inherited some six or eight ounces of this solution from his father. At the time his father had given this solution to him, he had said: "Whatever application or solution you get for the treatment of cancer, it must have selective power, and it must have the power of going into the tissues and selecting from them the cachoplastic elements and destroying them without destroying the healthy tissues." Another statement was that it should be applied for some distance around the outside of the cancer, as this choked the circulation, and so controlled to a certain extent the growth of the cancer. It seemed to him, therefore, probable that the electrolytic method of carrying in this solution might be a valuable one.

Regarding the use of such strong currents, Dr. Nunn said that he thought that it had been pretty well laid down as a principle

that the same amount of work could be done by a given amount of amperage and voltage, and distributed over a longer time; in other words, 500 m.a. could be distributed over a longer time and accomplish the same amount of chemical or mechanical work as would be accomplished by the stronger current in a shorter time. The question, therefore, was as to which was the better for the patient, the milder current and slower method, or the stronger current and quicker method. For these reasons he was opposed to the use of extraordinarily large currents. He was also opposed to them for the reason that he had found that small currents, given at intervals and persistently kept up, would produce as good, if not better, results. In a previous paper, read before the Association, he had cited the case of a lady suffering from cancer. A cancer is like rotten eggs in a barrel; if all but one of the rotten eggs were removed, and more eggs put in, they would all become rotten also. All the cancerous tissue could not be removed in a very short time by a strong current. Another case was mentioned in illustration, a lady of fifty-six years, with a large cancer of the left breast, $2\frac{1}{2}$ x $3\frac{1}{2}$ inches. There was involvement of the glands of both axillæ. This patient was treated with small currents, such as she could bear, the negative pole being placed on the tumor, and the positive pole in other places. The reason for placing the negative pole on the tumor was that he firmly believed that the flow of the current in a certain direction did have an influence on the "flow of the disease." The edges of the tumor were well defined in this case, and exceedingly hard. Under the influence of the treatment the edges softened, and the tumor did not increase in size, while the glands in the axillæ began to disappear. These treatments were kept up daily for six months, and during this time the skin was neither burned nor broken by the current. Then some mind-curers got after this woman, and she left him for six months. On her return the tumor had increased to 9 x 13 inches, and there was an ulcerated surface fully the size of the original tumor. This case seemed to him illustrative and confirmatory of the position he had taken in this matter. The question of priority was hardly worth talking about; we should be chiefly concerned with the method which will give the patient the most relief. He firmly believed that mild currents,

long continued, would act better than any other local treatment that could be employed.

Dr. MASSEY, in closing the discussion, said that he thought we could safely place ourselves in the position of Dr. Senn, of Chicago, who, in a very valuable work, narrowed the subject down to true cancer, where the skin and mucous membranes are affected, and sarcoma, which arises in the deeper tissues. In his paper to-day he had included both varieties under the general term "cancer." He was convinced that in the treatment advocated quicker results could be obtained in sarcoma than in true carcinoma. In the year 1895 there were five hundred deaths in Philadelphia from cancer alone. Why were not these cases cured if the cure were so easy as some would have us believe? He had not mentioned in the present paper that cancer had been cured years ago, nor had allusion been made to the exhaustive paper presented to this Association by Dr. Newman a few years ago. He only advocated his method because he considered it a distinct improvement. As to what became of the mercury, he would say that in the last few years he had used up several pounds of mercury on his instruments. He did not know where it had gone, if not into his patients. If a copper electrode were amalgamated with mercury, and only 30 m.a. were used for five minutes—*e.g.*, in an intra-uterine application—it would be found that very little mercury would be left on the electrode. This seemed to dispose of the objection raised by Dr. Bishop. In dealing even with sarcoma, he thought that the quicker the result the less the likelihood of secondary deposits in other parts of the body. Cancer is not a general disease primarily; at first it is local. His method was only available in those cases in which the cancer was still local. As to the strength of the current, he would simply ask which would be the better plan to quell a riot, to send one or two soldiers at a time, or a large number, and mass the strength of the military forces?

The whole subject was still very little understood. He thought electro-therapeutics was destined to throw much light on this subject, and particularly to afford much ground for encouragement in the department of cataphoresis.

The Treatment of Urethral Hyperæsthesia in the Male.

By Charles Howard Lodor, A.M., M.D., Chicago, Ill.

We all meet with cases of urethral hyperæsthesia and find them difficult of cure. The method of treatment I wish to present is in no way new, but is so singularly successful and so often neglected or improperly applied that I wish to call renewed attention to it.

Before going into the details of treatment, I wish to premise somewhat as to the condition of the patients. In speaking of urethral hyperæsthesia, I recognize it as frequently a symptom of a general pathological condition; but so widespread and disastrous are the results that, for the time being, the symptom becomes the chief source of anxiety.

The condition may prevail as a sequence or concomitant of masturbation; as a sequence of gonorrhœa; as one of the symptoms complex of neurasthenia; as a sequence of excessive venery; as the result of injury, as, for instance, from excessive bicyle riding; and more especially from a constant flushing of the parts involved with blood as a result of stimulation of the central sexual area, a prolonged erythism not of hours but of months or years.

Widely differing are the various methods of causation, and just as widely different are the general conditions of the patients. But whether by the rout venery, neurasthenia, or gonorrhœa, the end is the same in each individual, and a condition produced which causes almost, if not entirely, as much disorder of the body economy as a tender ovary in the female.

From a study of my cases, so far as the urethræ are concerned, I find two classes: those with pale or apparently anæmic mucous membrane; and those with red, dry and congested membrane. In almost all of these cases ejaculation takes place very soon in coitus, and not a few are impotent from inability to copulate from lack of erectile power or from asperism, the result of constant losses. Very few complain of any severe pain in the urethra; the distress amounts to no more than a discomfort, but

the tender point or points become very apparent upon use of the sound, bougie, or endoscope. There plays from the sensitive area a constant stream of nerve impressions to the spinal centres, causing widespread reflex disturbances. In the earlier stages the local irritation keeps up a constant erythism of the reflex arc, with over-secretion of both prostatic and testicular fluids, with too ready response to any form of excitation. Later in the disorder there follow the usual signs of cell exhaustion and over-stimulation ; the parts lose their functional power.

For purposes of present study, I exclude all causes of genito-urinary disturbance, save hyperæsthesia of the urethra. In all cases, before instituting treatment a most careful study of the individual urethra should be made. By sound, bougie *à boule*, and endoscope the various areas of mucous membrane should be mapped out and the tender areas noted. Just as in stricture of the urethra, so in hyperæsthesia of the urethra, there are certain points where tenderness is more likely to be found. In cases where gonorrhœa has formed a part of the antecedent history, or masturbation, extending over a long period, the local tender area is usually in the penile urethra from one to three inches back from the meatus, resembling the stricture of large calibre, and frequently is quite limited, not being more than one-quarter to one-half inch in extent. As a result of excessive venery or of prolonged excitation of the nervi erigentes from the higher centres, an area of tenderness develops in the deep urethra or in the prostatic portion, and often an inch or more in length. In this form there is not infrequently an oozing of prostatic fluid and a showing of fluid at stool and upon straining. In hunting for these tender points, when there is a little doubt as to their extent, I find great assistance from a weak current passed through the exploring sound. Not only is the pain more manifest, but owing to the increased vascularity of the tender area, a rise in the amperage is shown, due, of course, to the diminished resistance.

After determining the extent and condition of the hyperæsthetic area, I commence treatment with either a Newman stricture electrode, an ordinary steel sound insulated to point of contact, or a conical copper bulb electrode. The negative electrode has seemed the one of choice for ordinary work, and my

preference has been rather for the insulated steel sound. In my own hands the best result has been obtained by passing the current for ten minutes, 10 m.a. The current strength is somewhat deceptive. If a pointed conical electrode be used, only a rim contact is made. The result is that the 10 m.a. are spread over only a very few lines of mucous membrane, and such contact often produces great soreness.

My guide in the treatment is in the amount and character of the secretion. Upon commencing treatment, under the negative pole the urethra secretes freely and the sound comes up covered with mucus and the products of electrolysis. In the course of six weeks to two months there is less and less secretion, until at length the sound is withdrawn almost dry. At the outset, treatment is best instituted every four or five days and the interval of treatment lengthened as time goes on.

Noting the great improvement in endometritis under the oxychloride of copper, I have attempted a similar treatment in the urethra, and believe the results to be good. My efforts have been cautious and the cases too few to draw definite conclusions, but from present results I believe the treatment merits further trial.

I have speculated somewhat as to the physiological action of the current which proves curative. In this case it seems to me the good results obtained follow, first, the rapid secretion which depletes the hyperæmic area, and second, the movement of healthy pabulum to the part by electrical osmosis, favoring healthy cell activity. As a secondary result, the pavement of epithelium becomes thicker and more resistant.

Current-Regulating Apparatus.

By Edward Jewell, E.E., Chicago, Ill.

The commercial current has come into such general use in the last decade for power and lighting purposes, that now in every well-regulated office building in our cities is found the lamp socket charged with electric energy ready for the electro-therapist to use in his work.

But between the lamp socket and the patient should be placed regulating apparatus so certain in its action as to insure the patient against the remotest possibility of accident. Current-regulating apparatus may be divided into two classes, rheostats and transformers. All devices in which the strength of the current is diminished by the addition of resistance in one way or another, are termed rheostats. Shunt rheostats are to be preferred to those which are wired in series. In the former the current has two separate and distinct paths, the patient being in a derived circuit and not in series with the line. The three resistance materials in most common use are water, wire and graphite. The care necessary in maintaining it in a pure condition, and its constant liability to damage other apparatus, makes water an undesirable resistance material. Wire is objectionable from the fact that to secure sufficient resistance, a large amount of very small wire must be used. This, when wound upon bobbins, becomes bulky and liable to injury from over-heating; also in wire rheostats, buttons or contact pieces are used to cut in and out the different bobbins, which is a disadvantage, inasmuch as a gradual increase and diminution of the current is thus rendered impossible. This brings us to the third material—graphite. In the early history of the graphite rheostat, it was open to criticism that the graphite easily wore off, and had to be frequently renewed. But in its later and more improved form this difficulty has been entirely removed by the adoption of better methods of applying the graphite. The instrument in its present form, with proper handling, should last a lifetime. With it the current may be regulated without step or shock, and with absolute steadiness, from the

1-100th part of a volt up to the full pressure of the battery or line. In using rheostats on dynamo circuits, a sixteen-candle power incandescent lamp is always placed in series with the rheostat. This avoids any danger from accidental short circuiting. Transformers are of two kinds, rotary and static. In general, the rotary transformer, or motor generator, is used for the direct current, while the static transformer is used for alternating current. The transformer is used in electro-therapeutics chiefly for transforming high voltage lighting currents to a low voltage for cautery purposes. Used in this way, it is much more economical than a rheostat. When using a rheostat in heating a cautery knife, only about 5 per cent. of the current taken from the line is consumed in the knife; the remaining 95 per cent. is dissipated in heating up the rheostat. A good transformer, by transforming the voltage of the line pressure to a voltage suitable for cautery purposes, enables one to use nearly all of the current taken from the line in heating the knife. It will be seen, therefore that the transformer is a much more economical instrument for cautery work than the rheostat. A type of transformer, for which there is considerable demand at present, is one for transforming the alternating current to the direct current. The apparatus designed by the speaker for this purpose consists of an alternating current motor, coupled to a direct current generator. There are two windings on the armature of the generator, one a 110V. winding for galvanic purposes, etc., the other giving an electro-motive force of eight volts suitable for cautery purposes.

In the last few years there has been much written on the danger of commercial currents, but many have failed to point out the fact that the danger lay not in the current itself, but in the imperfectly constructed apparatus used for its control. Those of the profession who have equipped with modern, reliable apparatus, have found the much advertised dangers of the street current to be a myth, existing chiefly in the minds of those not thoroughly familiar with it; but to those who hesitate to adopt it from fear of a possible accident, the speaker would suggest a combination of the rotary transformer and rheostat. By this method the street current becomes simply a mechanical force used to generate another similar current, which is controlled by the rheostat in the usual

way. By this method there is no electrical connection between the patient and the street mains.

In closing, I will say that once having used the street current, the battery is rarely, if ever, again resorted to.

DISCUSSION.

Dr. R. J. NUNN, of Savannah, Ga., said that he knew of but one thing in the way of the use of the street current, and that was the accidental crossing of the wire with a fatal current. The current from the street might be used for many years without such an accident, yet this accident might occur the very first time the current was used. If this one danger could be eliminated, we would be satisfied. Where the wires are overhead, and trees are liable to fall and break down the wires, there was always danger. All the appliances recommended as safeguards required a certain time to act, and there was the difficulty. The speaker said he had in mind two cases of persons who had been seriously injured by a "dead" wire which had suddenly been crossed by a "live" wire. He would ask how this one great danger was to be guarded against?

Dr. MARGARET A. CLEAVES, of New York, said that she thought the way had been pointed out at the meeting in Boston last year, in a paper by Mr. Hammer. He advocated the use of the motor-dynamo as a safety device. Personally, she had used the street current ever since 1893, using simply a wire resistance, such as the Kennelly adapter. If she were newly equipping her office to-day she would insert a motor-dynamo, and so avoid all possible risk. Of course, in New York City, where the wires are underground, these dangers were reduced to a minimum.

Dr. G. B. MASSEY, of Philadelphia, Pa., said that he had used the Edison current in Philadelphia for a year and a half in a direct circuit, without even protecting the instrument by a lamp in series. He had, so far, had no accident. The conditions were so varying in different towns that it was not easy to settle the question for all localities. The lamp in series protected the instruments from over-charging and, as a result, of short-circuiting. He had discouraged the use of the current from the overhead wires, not

only for the reasons already given, but because of the possible danger of the current being turned off while the patient was being treated. With the Westinghouse current of 54 to 100 volts, obtained from the transformer on the outside of the house, a Faradic current could be obtained by inserting the graphite controller in series. It produced, however, a rather painful current. It would be useful in general practice, as in the control of post-partum hæmorrhage. With the incandescent current of the Westinghouse system, a very simple transformer could be used—*i.e.*, a Faradic coil—the current being taken from the primary coil.

Mr. JEWELL, in closing, said that he would have stated in his paper the method of protection, had it not been so thoroughly discussed last year in Boston. The motor-generator, in the form sold to the trade, had two commutators, one on either end of the armature, and the windings were parallel to each other. This he did not consider a protection under the conditions mentioned by Dr. Nunn, for in a thunder-storm a disruptive discharge might take place through the insulation and reach the patient's circuit. An absolute protection would consist in taking two one-eighth horse-power shunt motors of any standard make and reversing the winding on the field coil of one motor. The ends of these shafts could then be connected together by a wood-fibre or other insulated coupling. This gave a motor and a generator coupled directly, but not a "motor generator" in the sense used by the trade. In this combination there was no possibility of harm to the patient. In most of the larger cities the current was generated in the building in which the physician's office was located, the electrical plant being a part of the equipment of the building. Under these circumstances the dynamo current could be very easily and safely used. By the insertion into the circuit of the device just mentioned, even in towns with overhead wires, absolute safety could be secured for the patient. All other methods fail to give *absolute* protection.

Galvanism as an Aid in the Treatment of Goitre.

By Caleb Brown, M.D., Sac City, Iowa.

In presenting the subject of "Galvanism as an Aid in the Treatment of Goitre," I wish to state that there are certain cases of this disease that are fit subjects for the surgeon, and in this, as in other diseased conditions, it is not right to subject our patients to medicinal and electrical treatment when their cases can be better cared for by operative procedures. In all the cases on which this paper is based, I considered them fit subjects for medicinal and electrical treatment alone.

I shall not occupy your time by giving statistics from the records of other physicians, but shall give the results of my own treatment and shall give my own conclusions, based on my own work as to the benefit of this agent. It is customary for the laity to consider all cases of enlargement of the thyroid gland as goitre, but we know that there are true tumors of this body which are not properly called goitre. We are taught that all true tumors are the result of proliferation of embryonic cells which, having lain dormant in the various tissues of the body until, being stimulated to growth by some local irritant or other cause, we have, as a result of such growth, a tumor corresponding in kind to the cells from which it sprang, and no doubt many times the initial change in the thyroid gland is that producing an ordinary goitre ; but this change furnishes the stimulus to the latent embryonic cells, and the result is a growth not amenable to medicinal or electrical treatment, unless it be electro-puncture, or, possibly, the injection of medicine into the gland.

Professor Senn, in his "Pathology and Surgical Treatment of Tumors," says : "The ordinary bronchocele, miasmatic struma, is not a true tumor, but an infective swelling, caused by an unknown microbe." We find the thyroid body to be composed of numerous minute, closed vesicles, the vesicles being distinct, in fœtal life lined with small cylindrical epithelial cells, and containing a fluid, differing in its consistence in individuals and at different periods of life. We also find an abundant supply of blood vessels. The

anatomical elements given play the principal part in the production of the various forms of the disease. This being the case, we can see that the variety of goitre will depend on the kind of tissue which is in excess. Authors speak of fibrous, follicular, cystic and vascular goitres according as one or other anatomical structure is in excess. However, the different varieties are not separated from each other by well-defined lines, they each partaking of the anatomical elements entering into their structure and shading into each other. If we have a preponderance of connective tissue, we have a correspondingly hard, resisting growth, while an increase in the size of the follicles with their contents gives us the follicular or cystic form less resistant and soft, as compared to the fibrous condition. If we have the vascular tissue increased, the blood vessels enlarged, we have the vascular form, in which we can sometimes detect pulsation, this being also softer than the fibrous goitre.

Exophthalmic goitre being clinically a distinct disease, it is not considered, either in the foregoing classification or in the cases given as the basis of this paper.

In my experience in the treatment of goitre where I have used electricity as an aid, I have found it necessary to use only the terms "hard" and "soft," the hard variety containing those cases in which there is a superabundance of connective tissue, and the soft being those in which the fluid contents of the follicles or the vascular tissue is increased out of proportion to the other elements of the gland.

To arrive at correct conclusions as to the merit of any line of treatment we should be able to compare our work with the results of other lines of treatment. This I can only do in part in the disease before us, as I have kept more complete notes of my late work since I began the use of electricity than I did previous to that time, but the record is complete enough to use to advantage, and to arrive at correct conclusions. I will not give tables of statistics, but will simply give the results of my treatment and the conclusions I have arrived at.

The cases given range in age from twelve years to fifty-six years. In 33 per cent. of my cases the connective tissue was in excess, the growth being hard and resisting. In these cases the

ages ranged from fifteen years to fifty-six years. Of the cases, 67 per cent. were of the soft varieties, occurring principally in girls and young women twelve to eighteen years of age.

Every case of either hard or soft goitre in which galvanism was used, was benefited to a greater or less degree. In all cases, other means, such as iodine, internally and externally, were used, with one exception, that of a patient about eighteen years of age, in which so little medication was used that we might say galvanism was alone the curative agent. This was a soft, moderate-sized goitre, in which the gland returned to its normal size, and has so remained, now a year since treatment was discontinued.

In the goitres of firmer growth, in which connective tissue predominated, no complete cure was effected, although there was improvement in every case. In one such case, a woman fifty-six years of age, who had had for several years a large, hard goitre, came to me complaining of some pain and troubled respiration from pressure on the trachea. I treated her one month only by electricity, in which time the pressure symptoms were relieved, as was also the pain, although her neck was reduced in size to the extent only of one-half inch in circumference. Another case, a girl fifteen years of age, has a hard resisting goitre. She is now under treatment, but no great progress has as yet been made toward a cure, although the gland is some smaller and softer than at the beginning of the treatment. I have noticed in the firmer growths that one of the most favorable indications of progress in treatment is a softening of the gland. Yet, on the whole, so far as effecting a cure is concerned, the treatment of fibrous goitre by means of electricity in my hands, even when combined with other means, has not been satisfactory, although unpleasant symptoms have been overcome and the patient made more comfortable; and even to procure this much, I consider electricity a valuable aid.

In 75 per cent. of the cases of recent, soft goitres occurring mostly in girls and young women the gland has returned to the normal or almost normal size and has so remained; in 25 per cent. of such cases the gland has grown smaller while under treatment, and even for a time after treatment has ceased, but soon began to grow again, and I have found that in cases where the gland enlarged again, treatment did not succeed so well as the

first time. In these cases also, as a rule, the gland grows more firm and resisting, possibly from latent embryonic cells being excited to growth and the gland taking on more the nature of a true tumor, and possibly resulting in a growth requiring operative treatment. In estimating the value of any line of treatment in this disease, especially in the soft varieties and in young patients, we must always remember that these cases many times get well without any treatment on our part, and our therapeutic measures may be only consistent with the successful efforts of nature which might have accomplished fully as much without out our aid. But I have seen goitre improve so many times under the use of galvanism combined with other means, that I cannot think it is always a mere coincidence. My method has been the use of galvanism alone, using a current strength of five to fifteen milli-amperes, changing the position of the electrodes, a part of the time having one electrode on each side of the tumor, but most of the time having the positive pole in the auriculo-maxillary angle or on the back of the neck, the negative on the tumor, occasionally reversing the poles and slightly shifting the position of each electrode quite often, as by frequent shifting of the electrodes we pass the current through all parts of the tumor more thoroughly and are less likely to irritate the skin unduly—one application lasting five to ten minutes and occasionally for a longer time, and making two to six applications a week, according to the case or the time the patient can devote to office visits. In case the patient does not have opportunity to give sufficient time for the most effective treatment, I frequently have him come for a certain time, say, one month, then discontinue the use of electricity for a month, and many times the gland will continue to decrease in size, until at the end of the second month it may have reached its normal dimensions, and the cure remain complete. I have never used electro-puncture, nor have I used cataphoresis sufficiently to form an opinion as to its value. I am thoroughly convinced that electricity used as above stated is a valuable aid in the treatmet of this affection.

In the soft goitres in young patients, recovery is more rapid, and a larger per cent. remain cured ; and even in the hard, fibrous, resisting goitres, or perhaps we should say, where the growth has assumed more the nature of a true tumor, the pressure symptoms

and those depending on the nervous system are more rapidly relieved and the patient made more comfortable.

In my earlier years in medicine I did not attach the importance to goitre in its early stages that I do now, or that the subject demands, and I believe that a great many general practitioners at this day do not consider this disease in its early stages as a matter of much importance, and inform their patients that such is the case. The line of treatment given is intended more particularly for soft goitres in their early stages, and in these cases it is certainly a success. And since we know that the development of a simple goitre may excite the matrices of embryonic cell, if such be present, to active proliferation and growth, producing a tumor which is more or less rebellious to any treatment, except it be surgical, we can see the importance of effective treatment of the disease in its early stages.

DISCUSSION.

Dr. C. R. DICKSON, of Toronto, Canada, said that for a number of years past he had given much attention to the electrical treatment of goitre, and hence he had been deeply interested in the paper just presented. A former paper of his had been published in the Transactions under the erroneous title of "Notes on Exophthalmic Goitre," when he had distinctly stated that this paper dealt with all other forms but exophthalmic goitre. It was not sufficiently accurate, he thought, to divide goitres into "hard" and "soft." Some goitres, containing fluid, had very tense walls, and might therefore be called "hard" goitres. Again, a goitre might be soft, and yet the contents might vary greatly in character, being quite thin, or very thick and grumous. For instance, in one case, one of the lobules had undergone fatty degeneration. As to the forms of goitre to be treated by percutaneous galvanism, he agreed with the author of the paper that the best forms were those occurring in young people. The fibrous forms were not suited to this treatment, but for electro-puncture. Sometimes he applied the positive pole over the tumor, and the negative pole at the back, instead of in the way described. The two periods of life in which the least satisfactory results were obtained in the treatment of goitre,

were in women shortly after puberty and at the climacteric period. In the cases of the latter class, the tumor, instead of being benign, was frequently malignant; hence the prognosis in such should be guarded. Some had claimed that many goitres recovered without treatment, but he had had a large experience in hospital with goitres that had been subjected to all sorts of previous treatment without success; hence, in the cases that had come under his observation it could be fairly said that the treatment was responsible for the cure. Cystic and fibro-cystic goitres were, of course, not amenable to purely galvanic treatment, requiring rather electro-puncture or other modifications of the treatment.

In answer to a question from Dr. Nunn regarding the rule which guided him in changing the method of applying the poles, Dr. Dickson replied that the change alluded to had usually been made by him when he had observed that the case was not progressing satisfactorily.

Dr. G. B. Massey, of Philadelphia, Pa., said that his experience would lead him to agree specifically with almost everything that had been said. He would not, however, exclude the exophthalmic goitres from consideration. In the latter class he was in the habit of applying the galvanic current to the nerves of the sympathetic system of the neck, in addition to applying them to the tumor. In six cases so treated, recovery had taken place in all, although after a considerable period of time. He thought invariable success would attend the proper treatment of cystic goitre by puncture and drainage. He had himself treated two such cases with complete success. In one of these not a trace was left of a goitre that had originally been of about the size of an orange. The tumor had been punctured and drained, and the treatment kept up daily so as to destroy the secreting surface. This greatly contracted, and, in time, the fibrous portion also disappeared. In one case there was slight septic infection, owing to his having used a platinum electrode without cataphoric action. In the other case, treated by mercuric cataphoresis, there was not the slightest septic infection, although the treatment had been carried on for six weeks.

Dr. Brown, in closing the discussion, said that he had not attempted a critical classification of goitres—this was altogether

too large a subject to be embraced in a paper for this occasion. He had become convinced that it was of but little importance which pole was applied to the tumor. He had had no experience with electro-puncture He wished to lay special emphasis on the significance of goitre, for it was commonly believed by general practitioners that goitres in young girls were not of much importance. Modern pathology showed us that this opinion was entirely erroneous, and that the goitre might soon grow larger, or still worse, become fibrous or fibro-cystic. If such a tumor were treated by a galvanic current while still in its early stage, its cure was a very simple matter; if delayed until a later stage, a grave surgical operation might be required. For exophthalmic goitre he believed the galvanic current was the best known remedial agent.

Further Studies of the Manifestations of Uric Acid, and their Treatment, Electrically and Otherwise.

By J. Griffith Davis, M.D., New York, N.Y.

In a previous paper I attempted to interest you in the various manifestations of the complex phenomena of uric acid and its salts. I gave Foster's definition of the chemical constituents of it, which, for the sake of reference, I will repeat now, $C_5H_4N_4O_3$. This for the chemical formation. The one general definition that will bear repeating again and again is, that uric acid and its salts are the result or product of nerve and muscle waste, *i.e.*, their ashes. Much has been written of this potent factor for evil within the human economy. In itself it is not disease, but its power to produce disease is really unlimited. Hence these thoughts materialize to call attention to the factors that aid in its production. Sometimes they seem very trivial, yet are none the less dangerous.

Wherever there are organs functionating, there is chemical action. As waste and repair are constantly going on in every part of the human economy, consequently in every portion of the body must the elements C,H,N,O be found, and no one organ can be the laboratory for their production or origin. From the crown of the head to the sole of the foot we expect to find them. Therefore we should be most interested in the methods best adapted for the elimination of the products of waste.

The great law of change is written on all things in this mundane existence, and when we compare our little individual universe with the great cosmos that surrounds us, we can scarcely realize the simile. Nature is very prolific, and the better we learn how to utilize her beneficent favors, the more cause we will have to appreciate our blessings.

If we study to bring harmonious action among the organs of the body, we secure health just in proportion to the perfection of this action. We would not expect a watch to record correct time if even a little cog or a balance wheel were out of place. When we come to consider the elements that compose uric acid

and note how little oxygen is in each molecule, compared with the constituents of other substances, we readily see why it is more harmful. Then, too, its law of crystallization is its greatest menace, its sharp corners tearing the delicate lining membranes of the vessels as it is forced along in the currents of the constricted canals of the circulation.

What we most desire is the knowledge of *how* to cope with this very formidable element in the retrograde metamorphosis of tissue. We want all the chemical knowledge to add to the therapeutics. It strongly reminds me of a game of "blind man's buff." While trying to seek all the avenues and side issues of this element which eludes our pursuit so adroitly, we are liable to be blinded by old theories. I have not had the pleasure of a perusal of Haig's book, but have read abstracts from time to time, and so far my experience coincides with his. We are all earnestly seeking to secure true data, and hence all articles contain some new ideas, and we thus help each other nearer the goal. It is "here a little and there a little." Reasoning by analogy, we may come to discover the obscure cause of so many malignant neoplasms. I have read recently a theory that white blood corpuscles (leucocytes) were the sentinels, so to speak, in the circulation, and on their integrity and abundant proliferation depended the power to combat the microbes, bacteria, etc., that invaded the circulation by breathing, swallowing and by absorption.

In case of a sudden shock, a sudden chilling of any portion of the body, the temperature is lowered at that special point, and a rosette of uric acid crystals may be formed as the noxious elements are scurrying along in the vessels of the circulation. We know, only too well, how they cut and tear the lining membranes of the kidneys and bladder, even to producing hæmorrhage. Why, then, is it not possible that the same damage is being done to the lining membranes of vessels of the circulation?

In the smaller ones at the point of anastomosis, certainly congestion would be the result of the smallest amount of leakage, where these sharp points prick the delicate coatings. Just at this juncture along comes a specific germ that has escaped the sentinels. It finds a fine nidus to set up on its own account, and, forsooth, you have a specific growth, benign or malignant according

to the law inherent in that special form of growth. The extravazated blood becomes organized, and the perverted function now is turned to supply the intruder or usurper. Again, they are slow or rapid in growth according to the law governing that specific form of growth; therefore, anything that is capable of perverting the function of any organ is a menace to health.

In regard to pregnant women who have flabby abdominal muscles, pressure of the gravid uterus becomes a source of danger. In such cases there is need of an artificial support, in the way of a well-fitting bandage, to keep the weight from the bladder and the dragging of the ligaments that support the organ. The weight retards the circulation in a measure, and aids in the retention of uric acid and its salts. We need also to guard women against foods that favor the formation of these salts in greatest abundance. We come to consider the steps to overcome and render nil these dangers. Perhaps the best thing to suggest would be exercise in the open air, particularly for the pregnant woman.

Perhaps the report of a case in point will be the best way to continue this phase of the subject: About twenty-two months ago, Mrs. L. H. reported at my office and sadly informed me that she was pregnant for the fourth time. Said she dreaded it, as she was sure to lose this child as she had all the others. I tried to reassure her; told her that she had come in such good season that in all probability we should find the cause of the difficulty and remove it, and thus save her child. We began to look into the details of her daily life. From the history given, I suspected that uric acid and its salts were playing the main role in the case. I ordered her to eat sweets very sparingly, coarse bread and as little starchy food as possible. It was almost impossible to wean her from her depression and fears of a fatal result to her child. At the beginning of the fifth month I had her commence with Sitz baths—not hot ones, as when we have pelvic inflammation, but beginning with a temperature of 100°, in five minutes lower it to 90°, and in five minutes more lower it to 80°, then a vigorous rubbing with a salt solution as follows: ℞. Sea salt, ⅔ of a cup, put into a quart bottle with pint of soft water adding 1 oz. each of aqua ammonia and spirits of camphor. Then fill the bottle with alcohol—keeping this for a stock bottle—having enough in a small bottle for each time, and not polluting

the whole with touch of hands that had been in contact with the body. This to stimulate the surface of the body and restore normal action to the skin. These directions were fairly well carried out.

The one important thing, exercise in the open air, we could not get her to take, from false modesty. I urged the claims of her unborn child. I reminded her that no true man or woman would make any invidious remarks about her condition, and surely she should not notice or care for the remarks of any others. I tested her urine frequently, and according to Ethridge's test, she was not voiding enough solids, uric acid, etc., the elimination not always being equal to the metabolic process. This was shown by the times she passed colorless urine. I began to administer benzoic acid from the true gum, 7½ grs. suspended in glycerine, conjoined with other adjuvants that were indicated and not incompatible. Parturition occurred April 4th, 1896. It passed off well. I had a friend from Nova Scotia, Dr. Kate J. MacKay, visiting me. Owing to the three previous fatal results, I begged Dr. Mackay to go to the house of this patient for a few days and coach the nurse (not a regularly trained one), and see if we could find the hidden cause of the difficulty. The baby came at 8 a.m. In the afternoon it began to cry, and kept it up all night, refusing to nurse. I was very anxious, as the mother informed me that was the way all the others had acted. Sabbath morning, April 5th, Dr. MacKay sent for me early. When I arrived she met me in the outer hall and said, "Doctor, I fear you are going to lose this baby, too. It is unable to nurse and is semi-comatose." Just previous to my arrival Dr. MacKay had put it into a Sitz bath, and raised the temperature as high as she dared, while it was in the water. Said she fancied it was a little easier.

I asked if it had urinated freely. She replied in the affirmative, but said: "I want you to examine the napkins, they are so dark." I took the worst one to the light; the moisture was absorbed, and the space was covered with glittering crystals of uric acid, plain to the sight, and very clear and well differentiated with a powerful pocket microscope. The secret was out; the poor little thing was fast going into uremic coma. As the case seemed desperate, I ordered more hot baths, and gave tablets of the

benzoate of soda one-sixth of a grain every three hours. It was the only method that came to mind by which I could introduce a salt of benzoic acid that would be quickly assimilated and would not depress. In a few hours it began to revive, and showed signs of hunger. It began in a few days to pick up and nurse well. I also had the bowels washed out with warm water, to hasten the removal of the meconium, also gave some syrup of rhei to get full alvine evacuations. The uric acid gradually disappeared, showing on the napkin for about ten days at least. I advised the tablets to be continued from this time on twice daily. The dose seemed a large one for so young a child, twenty-four hours old, but I believe anything less and the child could not have lived.

This baby has now passed through her second summer, and is a fine, healthy little girl, very promising, and a great joy to her father and mother. I have warned them, that with such an early manifestation of the tendency to retain uric acid, they will have to be careful in regard to dietetics and hygienic conditions generally, and, above all things, to keep her in woollen garments, to keep her from any sudden chilling of the body. One other thing I have not mentioned, and that was the constant complaint of the mother of extreme nervousness, which I am quite sure now was caused by the retention of uric acid and its salt, and the feeble elimination of them, as the fœtus was dependent upon her, and she worrying all the time and unconsciously unloading the toxic elements into its body, well-nigh precipitating the very result she feared.

We have some symptoms so obscure that a mistaken diagnosis is the result. A case here will point this phase. Mrs. A. D. came under my care in 1893. She had an apparent hyperæsthesia—could not keep still. She characterized it as "creeps." She said it felt almost like worms under her skin. She said it was malaria, and she had had it for nine years, off and on. I asked her who told her it was malaria. She replied, a homœopathic physician who had attended in her family for years previous to her coming to me. I told her there was surely an error in diagnosis, as I thought her symptoms indicated uric acid. I asked her if she had noticed an elimination of colorless urine.

She replied that there was always a great amount of it previous to these attacks. I put her at once upon the benzoic acid treatment, 7½ grains three times per day to begin with. She had a furred tongue, thickly covered with white coating. I ordered her half a teaspoonful of sodium phosphate in cup of hot water one hour before her meals. I forbade coffee, green beans, tomatoes and asparagus, also sweets in excess; ordered her to use stale bread toasted, and as little starchy food as possible. Within twenty-four hours there was a marked change for the better, the urine promptly showed color, with quite a sediment, and finally to a normal condition. I warned her, that any departure from this toward a spring water appearance threatened a uric acid storm, its severity depending upon the amount of the retained toxic elements. I had the satisfaction of seeing her come out of the condition like magic. She proved a very grateful, appreciative patient. As she had developed the diathesis, she was cautioned to be very vigilant and on the alert for this insidious foe.

Its causes being legion, hence its reflexes would be legion. Therefore it requires precept upon precept, "line upon line" to meet and explain its effects. We could go on and report cases from the new-born infant, down through all classes and people, to the hoary heads. We want to detect this foe in all his phases and complications, as the functions of any and all organs are liable to be perverted.

As the skin is the largest organ, as it covers most space, it is the most important one to look after. I believe it to be second to none, as it is capable of doing its own normal work, and in emergencies can be made to do vicarious work for the internal organs, any or all of them. It reminds me of a well-appointed theatre with so many exits in case of danger. We can open all the sluice-ways (so to speak) and drive the intruders out.

Heat, applied by many methods, becomes a powerful aid on account of its double action; it relaxes the pores and dissolves the crystals. This fact alone should be remembered in time of danger, as it can be readily proven. We can utilize it so readily, even before we can bring our next most important factor, electricity, into use. In this connection I will report a case. Mrs. A. L. came under observation January 10th, 1878. She was seven months

pregnant. (The writer was then practising in Philadelphia.) The patient was œdematous from head to foot; I felt certain that with all I could do I would have a case of eclampsia; I could not shake the grim foreboding off. I consulted with Dr. Anna E. Broomall, then resident physician of the Woman's Hospital, now Professor of Obstetrics in the Woman's Medical College of Pennsylvania. I am much indebted to her for professional advice and counsel through the trying ordeals of the case. I did not think best to use electricity in that stage of the case. I began at once with vapor baths frequently and massage nightly, according to Dr. Wier Mitchell's instructions, finishing with upward movements to hasten the emptying of the venous circulation. This aided in securing sleep. Parturition occurred March 2nd, 1878. Just about the completion of the first stage, everything seemed to be moving along normally. Dr. Broomall entered the room and asked how matters were progressing. I replied very favorably. Dr. Broomall walked up to the bed, and looking at the patient, noticed her strange appearance and at once recognized that something was wrong, and she turned towards me and exclaimed in great consternation, "Oh, Dr. Davis! Eclampsia!" Away she flew to the Woman's Hospital for help. The patient had the severest convulsion I ever witnessed. Dr. Broomall returned in a few minutes with another physician and we put the patient under ether at once. The second convulsion occurred within twenty minutes. The head of the fœtus was so far advanced that Dr. Broomall delivered by enucleation. Another spasm occurred before the delivery of the placenta. In all there were four convulsions. The child was resuscitated. We all thought the mother could not recover. Dr. Broomall used the catheter emptying the bladder. The urine was very dark and coagulated solidly. We met every emergency of the case as fast as they arose. She hovered between life and death for many days. The one great trouble here was insomnia. We tried morphine, a grain in divided doses, hypodermically, and one-fourth of a grain by the mouth. We tried chloral, whiskey and all we could think of in medicine, and no sleep. At this juncture she was in such a severe tension tendons were contracting. I had an inspiration to give her the sulphate of atropia, $\frac{1}{100}$ of a grain. Within two hours she fell asleep and slept for four hours. I

repeated the atropia $\frac{1}{100}$ of a grain in twelve hours, and again in twelve hours the $\frac{1}{100}$ of a grain. I had then the toxic manifestation of the drug and stopped. Then I resorted to electricity (the great earthly savior in her case), as the atropia had apparently tided the patient over the immediate crisis. I then resorted to a Kidder battery; had one long flat electrode down the spine attached to the negative pole, a pair of slippers with plates in attached to the positive pole, electrodes in her hands also attached to the positive pole. I gave the current from the primary coil, as I thought it more soothing; this would invariably put her into a quiet sleep, and profound enough to remove the electrodes without disturbing her. This was her regular nightly hypnotic. I gave her special treatment at regular intervals for liver, kidneys and bladder to aid their normal action. There was a history of cystitis and constipation of long standing. The electricity seemed to do more for this case than all else put together, as all the emunctories were restored to normal action. We had four consultants; all gave an unfavorable prognosis. It seemed scarcely possible that any human means could reach a case so far reduced. With it all, she developed a most formidable bed sore. We were dreading its results on account of the danger of blood poisoning in her extremely low condition. Again electricity became my sheet anchor, and soon restored the parts to their normal condition, much to the surprise of my *confreres*, as at that date (almost twenty years ago) the profession were still looking askance at electricity. It had been in the hands of quacks so long we were fain to ask with one of old, "Can any good come out of Nazareth?" (so to speak).

Our teacher the previous winter in the Woman's Medical College, Dr. Hannah T. Croasdale (and now Professor of Gynæcology there), had called our attention to the possible worth of electricity in just such cases (bed sores). I remembered the suggestion and at once put it into practice, with the happy result of an immediate cure. It goes without saying, I was as happy as the patient. I kept up regular treatment with electricity for several weeks. The woman was restored to health, and, although such grave conditions obtained, for such a long period, she is still living—at least a letter this past summer bears me out in this assertion. I reported three severe cases in a previous paper, yet

I consider this one of the gravest and most severe cases of my twenty years in practice, and that electricity was my main hope in her case was amply proven ; while the judicious administration of medicine, as indicated, secured a final restoration to health.

While searching for causes, we must not neglect the little leadings. Fatigue, depression of spirits, worrying, etc., are all powerful factors in destroying the appetite and interfering with digestion. As we stated before, white blood corpuscles are the sentinels that destroy microbes of all sorts. These are most profuse after eating, hence hunger long continued becomes an important element. Fear is another element limiting the number of the leucocytes. Therefore, weakness of the body, however caused, produces like results. In regard to these protecting corpuscles, one writer says, "Weakness caused by fear plays an important role in the predisposing cause of infectious diseases."

Fatigue not only limits the number of the leucocytes and their vitality, but it diminishes the calibre of the blood vessels as well, interferes with the circulation, and thus limits the supply of these corpuscles at any given point. The veins are loaded with the return fluid, gathered up from all parts of the system, going to the heart, thence to the lungs to be purified. (Cremation to all intents and purposes of the débris of the whole system.) The venous circulation being on the surface is more easily affected by sudden cold, dampness, etc. I read in the last issue of the "Journal of the American Medical Association" a report from a physician from the Klondike that the most formidable disease and most prevalent was rheumatism, proving this. Would I had the eloquence of a Demosthenes, that I might draw a pen picture of the workings of this insidious foe to human life.

There are many fads in medicine, as well as in other fields. We want in this case the most practical methods possible, and to get at it in its entirety we would need the wisdom of a Solomon. Another source of danger is a clogged-up portal circulation. We want to keep before our mind the fact that the element C H N and O are present in every part of the body. They get there through the natural processes of metabolism and the retrograde metamorphosis of tissue—the food we eat, the air we breathe and are bathed in by the surrounding atmosphere ; therefore we must

consider every phase to approximate a law of defence, as it were. It is the experience of the greatest number, that to clothe the body in garments that secure the greatest immunity from shock under all conditions is the desirable thing. It seems to be the consensus of opinion that wool meets this indication better than anything else. A French physician wrote some years ago, that if he could clothe every person in wool, three-fourths of the physicians would close their offices for want of patients. From my personal experience I am inclined to corroborate his theory. (Of course, there are some people with personal idiosyncrasies that cannot wear wool next to the flesh; they are greatly in the minority, however.) Light-weight wool in summer and heavier in winter. Woollen fibre does not pack like cotton fibre, and retains free air in its meshes. If it gets damp, does not feel chilly like cotton fibre, under same conditions. To sum up: Keep the body as nearly an even temperature as possible by whatever means you can make available. Try to control mental condition and forces of the body to prevent extremes in all directions. Above all, keep the liver and skin in normal condition. The food and the manner of its preparation plays a very important role in securing proper action of the liver. Of all the sins in this category, I do think fried foods rank first as liver disturbers. They are so frequently bolted without proper mastication—a lot of incongruous stuff put into the stomach that cannot digest there, and simply ferments. They are passed on to the duodenum to meet the bile and pancreatic juice—they cannot cope with the mass. The proper metabolism is out of the question. The offending elements hold high carnival, and from these fermentative materials are evolved the very gases we dread, C H N and O. Under favoring circumstances they unite to form our formidable uric acid. The lacteals cannot get their legitimate papulum; they therefore take what they can get, and the evil elements are distributed to all parts of the circulation.

It has been asserted that malignant disease was fearfully on the increase. May this not be traced to the great consumption of food which notoriously favors the formation of uric acid? For instance, within my memory tomatoes were considered poisonous. They were fair to look upon, and, Eve and Adam like, we were prone to cultivate a taste for them. Experiments were tried in some of the

French hospitals with foods. It was proven that much more uric acid was formed after the ingestion of tomatoes, green beans and asparagus. It is not the question of how much uric acid is formed, however, as the power to eliminate it.

We cannot pass without a tribute to the bicycle, properly used. I have known several, personally, who were victims for years to rheumatism, who scarcely know what it means since they began the use of the wheel. That some suffer from the injudicious use of the wheel is no argument against it, as such persons would suffer from indiscretions in any direction and from all circumstances. We have noted the necessity for the normal action of all the organs of the body, the avoidance of the undue use of sweets, starches and fats. We must not omit an admonition against stimulants as beverages. Where there is low vitality and age advancing, stimulants may be of advantage, but where there is plenty of blood and circulating freely, and the person naturally robust, surely stimulation, even with strong tea and coffee, should be prohibited, and much more, the stronger stimulants. Even members of the profession—who are sufferers—wince over the need to avoid stimulants. The trouble is this: Those who are the victims of bad habits in this direction are stultified by them and cannot agree to these propositions. They will stick to their idols till grim disease overtakes them, and they find they cannot retrace their steps. The poor organs have been goaded till they refuse to functionate. Dire are the consequences.

I have not aimed to give a learned paper, but more of a practical summing-up of the little factors that make up this question. We want to remember that "It is the little foxes that spoil the vines." I feel that I have not done, and cannot do justice to the subject. It is so important and plays such a mighty part in producing human suffering.

In acute manifestations that threaten I use medicine; when they have become chronic I use electricity to reach the congestions that have become rampant in different parts of the body. For its chemical, mechanical and physiological action I have used mostly galvanic and Faradic currents. I am also much in favor of the static variety for some people. I wish before closing to reiterate one more admonition, and that is, to emphasize the necessity for

the frequent flushing of the colon to remove the effete matter that is so sluggish in its movements in its final exit from the body. I aim to treat patients as much as their ailments, and to restore lost equilibrium, as health depends on every organ of the body functionating in a normal, physiological manner.

DISCUSSION.

Dr. J. GERIN, of Auburn, N.Y., said that he agreed with the points made in the paper in every particular, except the author's statement that the paper was not a "learned" one. It seemed to him an exceptionally practical and interesting contribution. He had studied the subject a good deal himself, and he felt under great obligations to the author for the valuable suggestions thrown out.

A New Electrode for Use with the Static Machine.

By Lucy Hall-Brown, M.D., Brooklyn, N.Y.

The object of this device is twofold—first, to enable the physician to administer a more efficient spray current of electricity to the patient than is possible with the electrodes in general use, and secondly, to do so without the possibility of having sparks jump from it to the patient.

The electrode is made up, as you see, of a bundle of rather fine steel wires, some four hundred in number, arranged in the form of a small whisk broom, held together by a metal sleeve, and attached to one end of a suitable wooden handle.

In this form the electrode may be used with either the "direct" or "indirect" static current, but as electro-therapeutists prefer to use the indirect method, it is advisable to replace the wooden handle for one of metal, such as a piece of light brass tubing. I have an electrode so arranged here. After the instrument has been in use some time, the wires get bent and twisted, and it is then better for our purpose than when all the wires are touching.

These wire brushes with the wooden handles can be had for ten cents by mail, from the manufacturer, J. F. Bigelow, Worcester, Mass.

DISCUSSION.

Dr. R. Newman, of New York, said that there was certainly an advantage in using this electrode; it was particularly convenient in the treatment of headache. The electrodes furnished by the manufacturers had thick, short, metallic points on a metallic base,

They were sharp and unpleasant and almost useless. Dr. Hall-Brown, one of our members, had devised an electrode consisting of one point, but when this was brought too near to the patient it produced an unpleasant spark. Another device consisted of about thirty or forty wires collected together on a base of copper. These wires were too far apart, and so the electricity leaped from one point to another. But the electrode just presented had none of these disadvantages, and could be used on the most nervous patient. Another advantage of the instrument was that it could be purchased for a few cents. The metal handle was a decided advantage if the operator stood away from the platform, and so did not get the electricity also.

A New Localizing Electrode to Prevent Diffusion of Current.

By J. Bergonié, M.D., Bordeaux, France.

The purpose of this electrode is to produce galvanization or faradization of muscles over which it is applied without permitting the current to be diffused to neighboring structures. Duchenne, of Boulogne, in his book on localized electrization, says that in order to faradize a muscle it is necessary "that the rheophore should cover the whole surface," but he recognized readily that it is difficult to localize the effects of the current with electrodes of any great size. For example, in paralysis from lead poisoning certain muscles of the posterior region of the atrophied forearm do not contract under the influence of the faradic current. If the intensity of the current is weak, we observe, as Duchenne has ascertained, no effect; but if we increase the intensity to thoroughly demonstrate the inexcitability of these muscles by the faradic current, then the diffusion of the current to the flexor muscles produces extensive movements of the whole member. This difficulty is even more objectionable and pronounced when, instead of using the bi-polar method, the two electrodes being applied to the extensors, we should use the mono-polar method, the active electrode being applied to the back of the neck or the sternum. These same difficulties are met with under numerous other circumstances, and sometimes it is very difficult to say whether a muscle of a certain group is completely inexcitable to the faradic current, as its contraction proper may pass completely unobserved among the active contractions of its antagonists.

It is in order to remove these inconveniences that this new localizing electrode has been constructed. It consists of a series of separate electrodes of variable dimensions, but always narrow in proportion to their length, say, 1 c. m. to 9 or 10 c. m. These are placed perpendicularly to the direction of the muscular fibres in a variable number, say, eight or ten or more, and connected alternately, one with the positive pole and the next with the negative

pole, the third to the positive, and so on, so that all the individual electrodes of even numbers are positive and the odd numbers negative. A very simple figure will show the course of the current between two individual electrodes of opposite polarity, and this current will penetrate in proportion to its intensity ; however, this intensity will have to become extremely high before any diffusion ever so slight will take place. We can then obtain with these electrodes an exact localization to the muscles on which it is applied, and obtain the best results, whether we use them for electro-diagnostic purposes or for therapeutic ends.

Palliative Electrical Treatment of Tic Douloureux of the Face.

By J. Bergonié, M.D., Bordeaux, France.

The treatment used by the author consists of the application of the galvanic current of high intensity and long duration by means of a large electrode, specially designed and applied to the face of the patient, connected to the positive pole of an electromotor. The circuit must contain an electromotor of continuous current giving 50 volts, a rheostat, a milli-ampere meter, two electrodes, of which the active one should have 200 to 250 square centimetres and the indifferent electrode about 400 square centimetres, the latter placed in the dorsal region. The conductors completing the circuit should be secure in their continuity and at the points of contact. The intensity of the current should be increased gradually to 35, 40, and finally to 50 milli-amperes. The periods of ascension and diminution should last one to ten minutes; the maximum intensity should be maintained for at least twenty minutes.

Clinical Results.—Among the patients to whom this treatment has been applied, ten have remained under observation during periods of from three to ten years. With all of them the painful attacks have considerably diminished as far as number, duration and intensity are concerned; with some of them the amelioration was so complete as to be considered a perfect cure. The author believes that the action of the current in this case is due to electrolytic phenomena which make themselves felt to the last ramifications of the affected nerve; and indeed, the spasmogenic area becomes almost insensible after an application, and absolutely no pain is felt. Furthermore, the anatomical disposition of that region suggests the thought that the current probably penetrates through the bone at the points where the branches and the trunk of the nerve emerge through it. It would therefore not be unreasonable to think that the trunks, as well as the termination of the nerves, are influenced. The author believes that the treatment which he advocates has no objectionable features, that it always brings relief from the intense pain characteristic of the disease, and sometimes after a certain length of time causes their complete disappearance.

The Action of the Roentgen Rays on the Vitality and the Virulence of Cultures of Koch's Tubercle Bacillus.

By Profs. J. Bergonié, M.D., and Ferré, Bordeaux, France.

These researches have been made on glycero-gelatine cultures. A first experiment was conducted to determine the action of the rays so far as the virulence was concerned, and the second to determine relative to their vitality. The exposure of the cultures to the X-rays has been especially carefully managed; the rays penetrated to the cultures through the opening of the tube closed by a cotton wad, and struck directly on the inoculated surfaces. Never were the rays made to go through the glass to reach the cultures.

A control guinea-pig was first inoculated with a pure culture, and two others, after an exposure of one hour, to the action of the X-rays. These rays were furnished by a focus tube which could produce a good radiograph after five or six minutes' exposure. Of these three guinea-pigs, the first died of tuberculosis on the 1st of July, the second on the 7th, and the third is still alive on the 28th, but clearly tuberculous. In order to examine the action of the X-rays on the tubercle bacillus, we have inoculated every day a new tube, each culture being exposed daily for one hour. Although certain tubes were inoculated with a culture that had been exposed to the X-rays for one hour for fifteen consecutive days, yet the inoculations developed perfectly on the culture medium, and large colonies of extremely lively tubercle bacilli were found.

The conclusions to be drawn from these experiments are: that under the circumstances in which we placed ourselves, the exposure of a culture of tubercle bacilli to the X-rays for the period of one hour, does not destroy the virulence of that culture, but seems to retard their evolution (seven days of survival in one case and nearly one month in the other). As to the vitality of the cultures it does not appear to be modified.

DISCUSSION.

Dr. G. B. MASSEY, of Philadelphia, Pa., said that the method described in the first paper seemed to him a very plausible one for localizing the electrical effect in a muscle for diagnosis — the probable object of the device.

Dr. R. NEWMAN, of New York, moved that Dr. Bergonié receive the thanks of the Association, and that an abstract of the proceedings of the Association be prepared and sent to him for publication in the paper of which he is editor. Seconded by Dr. Cleaves, and carried unanimously.

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