

LIST OF BRANCHES.

Revised to January 1, 1913.

Name and when Organized.	Chairman.	Secretary.
Agricultural and Mechanical College of Texas. Nov. 12, '09	S. E. Bowler.	E. S. Lammers, Jr. College Station, Texas.
Arkansas, Univ. of. Mar. 25, '04	W. B. Stelzner.	G. W. Watkins, Room 25, Buchanan Hall, Fayetteville, Ark.
Armour Institute. Feb. 26, '04	W. Fryberg.	R. L. Walsh, Armour Inst. Tech., Chicago, Ill.
Bucknell University May 17, '10	E. M. Richards.	Robert L. Rooke, Bucknell University, Lewisburg, Pa.
California Univ. of. Feb. 9, '12	Charles Grunsky.	C. I. Kephart, University of California, Berkeley, Cal.
Cincinnati. Univ. of. Apr. 10, '08		
Clemson Agricultural College. Nov. 8, '12	J. H. Kangeter.	H. J. Bomar, Clemson College, S. C.
Colorado State Agricultural College Feb. 11, '10	Robert O. Sewell.	R. K. Havighorst, Colorado State Agricultural College, Fort Collins, Colo.
Colorado, Univ. of. Dec. 16, '04	Harry McKinney.	Seizo Uyeda, 1075 12th St., Boulder, Colo.
Highland Park College .. Oct. 11, '12	J. W. Spooner.	Ralph R. Chatterton, Highland Park College, Des Moines, Iowa
Iowa State College. Apr. 15, '03	H. C. Bartholomew	F. A. Robbins, Iowa State College, Ames, Iowa.
Iowa, Univ. of. May 18, '09	L. F. Hatz.	A. H. Ford. University of Iowa, Iowa City, Ia.
Kansas State Agr. Col. ... Jan. 10, '08	B. F. Hillebrandt.	W. C. Lane, Kansas State Agric. Col., Manhattan, Kan.
Kansas, Univ. of. Mar. 18, '08	S. S. Schooley.	A. J. Fecht, Univ. of Kansas, Lawrence, Kan.
Kentucky, State Univ. of Oct. 14, '10	R. B. Pogue.	W. M. Lane, 216 Rose Street, Lexington, Ky.
Lafayette College. Apr. 5, '12	F. W. Mauc.	W. O. Hay, Jr. Lafayette College, Easton, Pa.
Lehigh University. Oct. 15, '02	W. J. Dugan.	E. F. Weaver, Lehigh University, S. Bethlehem, Pa.
Lewis Institute. Nov. 8, '07	Ralph Kilner.	A. H. Fensholt, Lewis Institute, Chicago, Ill.
Maine, Univ. of. Dec. 26, '06	Howard O. Burgess	J. Larcom Ober, S. A. E. House, Orono, Maine.
Michigan, Univ. of. Mar. 25, '04	Ward F. Davidson	Edward A. Roeser. Univ. of Michigan, Ann Arbor, Mich.
Missouri, Univ. of. Jan. 10, '03	H. B. Shaw.	E. W. Kellogg, 9 Engineering Building, Columbia, Mo.
Montana State Col. May 21, '07	Lawrence Wylie.	J. A. Thaler, Montana State College, Bozeman, Mont

LIST OF BRANCHES.—Continued.

Name and when Organized.	Chairman.	Secretary.
Nebraska, Univ. of.....Apr. 10, '08	Geo. H. Morse.	V. L. Hollister, Station A, Lincoln, Nebraska.
New Hampshire Col.....Feb. 19, '09	Robin Beach.	Clayton W. Work, New Hampshire College, Durham, N.H.
North Carolina Col. of Agr. and Mech. Arts....Feb. 11, '10	S. B. Sykes.	J. W. Johnson, N. C. College of A. and M. Arts, West Raleigh, N. C.
Ohio Northern Univ.....Feb. 9, '12	F. M. Billhimer.	J. E. Wineland, Ohio Northern University, Ada, Ohio.
Ohio State Univ.....Dec. 20, '02	R. E. Kinhead.	T. O. Farmer, Ohio State Univ., Columbus, Ohio.
Oklahoma Agricultural and Mech. Coll.....Oct. 13, '11	A. P. Little,	J. W. Harvey, 416 Hester Street, Stillwater, Okla.
Oklahoma, Univ. of.....Oct. 11, '12	David E. Renshaw	Leo H. Gorton, 526 University Boulevard, Norman, Okla.
Oregon Agr. Col.....Mar. 24, '08	Lance Read.	Charles E. Oakes, Oregon Agric. Col., Corvallis, Ore.
Oregon, Univ. of.....Nov. 11, '10	R. H. Dearborn.	C. R. Reid, Univ. of Oregon, Eugene, Oregon.
Penn State College.....Dec. 20, '02	K. P. Fuhrman.	I. S. Nippes, Pennsylvania State College, State College, Pa.
Purdue Univ.....Jan. 26, '03	C. F. Harding.	A. N. Topping, Purdue University, Lafayette, Ind.
Rensselaer Poly. Inst..Nov. 12, '09	E. D. N. Schulte.	W. J. Williams, Rensselaer Poly. Institute, Troy, N. Y.
Rose Polytechnic Inst...Nov. 10, '11	S. Irwin Stocking.	Joseph E. O'Connell, 457 N. 8th Street, Terre Haute, Ind.
Stanford Univ.....Dec. 13, '07	Gustav Wade.	Walter J. Dodge, Stanford University, California.
Syracuse Univ.....Feb. 24, '05	W. P. Graham.	R. A. Porter, Syracuse University, Syracuse, N. Y.
Texas, Univ. of.....Feb. 14, '08	J. A. Correll.	N. H. Brown, University of Texas, Austin, Tex.
Throop Poly. Inst.....Oct. 14, '10	Ray Gerhart.	R. W. Parkinson, Throop Poly. Institute, Pasadena, Cal.
Vermont, Univ. of.....Nov. 11, '10	Walter L. Upson.	O. Krupp, 65 North Bend St., Burlington, Vt.
Virginia, Univ. of.....Feb. 9, '12	Walter S. Rodman	Henry Woodman Clark, A. X. P. House, University, Virginia.
Wash., State Coll. of....Dec. 13, '07	M. K. Akers.	H. V. Carpenter, State Col. of Wash., Pullman, Wash.
Washington Univ.....Feb. 26, '04	C. E. Wright.	A. S. Blatterman, Washington University, St. Louis, Mo
Worcester Poly. Inst...Mar. 25, '04	Harry B. Lindsay.	George I. Gilcrest, Worcester Poly. Inst., Worcester, Mass.
Yale University.....Oct. 13, '11	E. C. Willard, Jr.	M. R. Wibberley, 361 Elm Street, New Haven, Conn.

Total 45.

PROCEEDINGS

OF THE

American Institute

OF

Electrical Engineers.

Published monthly by the A. I. E. E., at 33 W. 39th St., New York, under the supervision of

THE EDITING COMMITTEE

GEORGE R. METCALFE, Editor

Subscription. \$10.00 per year for all countries to which the bulk rate of postage applies.
All other countries \$12.00 per year.
Single copy \$1.00.
Subscriptions must begin with January issue.

Changes of advertising copy should reach this office by the 15th of the month, for the issue of the following month.

Vol. XXXII **February, 1913** No. 2

A. I. E. E. Regular February Meeting Omitted

As announced in the report of the Directors' meeting of January 10, it was voted to omit the regular New York meeting of the Institute for February 14, in order to concentrate every effort upon the Midwinter Convention, February 26—28. The regular monthly meeting of the Board of Directors will be held on February 14, 1913.

A. I. E. E. Midwinter Convention Announcement

The New York Midwinter Convention of February 1913 is to be held under the auspices of the Standards Committee, which is preparing data for a revision of the Standardization Rules. Recent investigation has shown that the present Standardization Rules of the American Institute of Electrical Engineers are inadequate to meet the most recent practise and tendencies. It was therefore considered desirable to pre-

sent proposed modifications to the electrical engineering fraternity for comment and suggestions before adopting them in the rules.

The list of papers to be presented at the convention is given herewith. The first two papers on the list, which are presented by the sub-committee on Revision of Rules, and the sub-committee on Rating, were printed for advance distribution as well as in this issue of the PROCEEDINGS, and it is particularly desired by the Standards Committee that written discussion should be furnished on these two papers, with a view to being printed in advance of the convention.

It is also desired to obtain, at the earliest possible date, written contributions to the discussion of any or all of the papers. Such contributions to the discussion as are received at the Secretary's office before February 10 will be printed in advance and will be available for distribution before the meeting on request. It is urged that all such discussion may present only constructive criticism so as to promote the objects for which the convention is held. These objects cannot be furthered by the expression of opinions other than those based on very careful consideration of the propositions involved. In order to be printed in advance, contributions to the discussion should be devoid of diagrams or illustrations.

It is proposed that in order to economize time for discussion, the papers already printed in the February PROCEEDINGS should be read by title or abstract only at the convention. Much importance is attached to the written contributions to the discussion as it is hoped that these will contain valuable suggestions and opinions of a wide circle of members and other interested parties who may have found it impracticable or inexpedient to contribute formal papers.

All of the papers for this convention are printed in this issue, except program Nos. 6, 28 and 45.

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PROGRAM

The papers are classified in the order of their presentation, under four groups, as follows:

Group I. Heating, Heat Measurements, Rating by Heat.

Group II. Methods of Determining Losses in Apparatus.

Group III. Methods of Testing Apparatus for Performance.

Group IV. Miscellaneous Subjects Relating to Rating.

Wednesday, February 26

10:30 A.M.

The Convention will open with a brief introductory address by the chairman of the Standards Committee, and will be followed by two sub-committee papers, as follows:

1. *Temperature and Electrical Insulation*, by C. P. Steinmetz and B. G. Lamme. (Sub-committee on Revision of Rules.)
2. *Method of Rating Electrical Apparatus*, by W. L. Merrill, W. H. Powell and Charles Robbins. (Sub-committee on Rating.)

The discussion on the sub-committee papers will be followed by the presentation by abstract of Group I papers, and their discussion.

This discussion will be continued in the afternoon.

8:00 P.M.

Conclusion of discussion on Group I papers.

Thursday, February 27

10:00 A.M.

Opening address by Mr. H. G. Stott upon the use of the "myriawatt" and "myriawatt-hour" in connection with rating; to be followed by presentation by abstract and discussion of papers in Group II.

This discussion will be continued in the afternoon.

8:00 P.M.

Conclusion of discussion on Group II papers.

Friday, February 28

10:00 A.M.

Presentation by abstract and discussion of papers in Group III.

2:00 P.M.

Presentation by abstract and discussion of papers in Group IV.

9:00 P.M.

Reception and dance at Hotel Astor.

Papers to be Presented at A. I. E. E. Midwinter Convention

February 26-28, 1913

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2. *Method of Rating Electrical Apparatus*, by W. L. Merrill, W. H. Powell and Charles Robbins. (Sub-committee on Rating.)

Group I. Heating, Heat Measurements, Rating by Heat

(a) MOVING MACHINERY

3. *Notes on Internal Heating of Stator Coils*, by R. B. Williamson.
4. *Measurement of Temperature on Rotating Electric Machines*, by L. W. Chubb, E. I. Chute, and O. W. A. Oetting.
5. *Method of Determining Temperature of A-C. Generators and Motors and Room Temperature*, by H. G. Reist and T. S. Eden.
6. *Thermocouples and Resistance Coils for the Determination of Local Temperatures in Electrical Machines*, by J. A. Capp and L. T. Robinson.

(b) TRANSFORMERS

7. *Methods of Determining Temperature of Transformers and of Cooling Medium*, by S. E. Johannesen and G. W. Wade.
8. *Methods of Measuring Temperature of Transformers*, by C. Fortescue and W. M. McConahey.
9. *Correction of Transformer Temperature for Variation of Room Temperature, Taking into Account Both Copper and Iron Losses*, by C. Fortescue.

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(c) TEMPERATURE CORRECTION

10. *The Temperature Rise of Stationary Induction Apparatus*, by J. J. Frank and W. O. Dwyer.
11. *Effect of Room Temperature on Temperature Rise of Motors and Generators*, by M. W. Day and R. A. Beekman.
12. *Effect of Air Temperature, Barometric Pressure and Humidity on the Temperature Rise of Electrical Apparatus*, by C. E. Skinner, L. W. Chubb and Phillips Thomas.
13. *A Laboratory Investigation of Temperature Rise as a Function of Atmospheric Conditions*, by C. B. Blanchard and C. T. Anderson.
14. *Laws of Heat Transmission in Electrical Machinery*, by Irving Langmuir.

(d) CABLE HEATING

15. *Current Rating of Electric Cables*, by R. W. Atkinson and H. W. Fisher.
16. *The Heating of Cables Carrying Current*, by S. Dushman.

Group II. Methods of Determining Losses in Apparatus

(a) INDUCTION MOTORS

17. *Induction Motor Load Losses*, by H. G. Reist and A. E. Averett.
18. *Stray Losses in Induction Motors*, by A. M. Dudley.
19. *Notes on Induction Motor Losses*, by R. W. Davis.

(b) TRANSFORMERS

20. *Losses in Transformers*, by W. W. Lewis.
21. *Stray Losses in Transformers*, by C. Fortescue and W. M. McConahey.

(c) GENERATORS, A-C. AND D-C.

22. *Determination of Load Loss Correction Factors for Rotating Electric Machines*, by E. M. Olin and S. L. Henderson.
23. *Load Losses of Alternating-Current Generators*, by W. J. Foster and E. Knowlton.

24. *Notes on Stray Losses in Synchronous Machines*, by F. K. Brainard.

25. *Stray Losses in Direct Commutating Machines*, by H. F. T. Erben and H. S. Page.

(d) ERRORS OF TESTS

26. *The Determination of Stray Losses from Input-Output Tests*, by L. T. Robinson.
27. *Sources of Error in Efficiency Determination of Rotating Electric Apparatus*, by Elmer I. Chute and William Bradshaw.

(e) BRUSH LOSSES

28. *Commutator and Brush Losses*, by W. N. Motter.
29. *Brush Friction and Contact Losses*, by H. F. T. Erben and A. H. Freeman.
30. *Methods of Determining Brush Losses Due to Contact and Friction*, by H. R. Edgecomb and W. A. Dick.
31. *Commutation and Brush Losses*, by C. E. Wilson.

Group III. Methods of Testing Apparatus for Performance

(a) GENERATORS AND INDUCTION MOTORS

32. *Comparison of Methods of Loading Large A-C. and D-C. Generators and Synchronous Converters for Factory Temperature Test*, by F. D. Newbury.
33. *Comparison of Methods of Making Load Tests on A-C. Generators and on Induction Motors*, by E. F. Collins and W. E. Holcombe.
34. *Notes on Method of Making Load Tests on Large Induction Motors*, by A. M. Dudley.

(b) TRANSFORMERS

35. *Load Tests on Transformers*, by J. J. K. Madden.
36. *Sources of Error in Transformer Tests*, by W. M. McConahey and C. Fortescue.

Group IV. Miscellaneous Subjects Relating to Rating

(a) OIL SWITCHES

37. *Rating of Oil Circuit Breakers with Reference to Rupturing Capacity*, by G. A. Burnham.

(b) SPARK GAP

38. *The Sphere Spark Gap*, by S. W. Farnsworth and C. Fortescue.
39. *The Calibration of the Sphere Gap Voltmeter*, by L. W. Chubb and C. Fortescue.

(c) WAVE FORM

40. *Potential Waves of A-C. Generators*, by W. J. Foster.
41. *Wave Form Distortions and Their Effects on Electrical Apparatus*, by P.M. Lincoln.
42. *A Proposed Wave Shape Standard*, by Cassius M. Davis.

(d) REGULATION

43. *The Experimental Determination of the Regulation of Alternators*, by A. B. Field.
44. *Regulation of Definite Pole Alternators*, by S. H. Mortensen.
45. *Generator and Prime Mover Capacities*, by David B. Rushmore and E. A. Lof.

Entertainment

It has been thought best to have this a working convention, and therefore no special entertainment features have been provided.

The following companies have, however, very courteously offered to open their stations for inspection by any members presenting a badge during the hours of 2 to 5 p.m. on each day of the convention.

New York Edison Co., Waterside Station,

38th to 40th St. & East River. Substation, 45 West 26th Street.

Interborough Rapid Transit Co., 59th St. Station,

59th Street and North River.

Sub-station, 264 W. 96th Street.

American Telephone and Telegraph Co., and the New York Telephone Co., Central Station, 15 Dey St.

The convention will close with a reception and dance to be held at the Hotel Astor, February 28, at 9:00 p.m. Arrangements for attending the reception can be made at the registration office.

NOTE. The New York Entertainment Committee will maintain an information bureau at the registration office, during the convention.

Registration

Each member and guest, upon registration, will receive a badge bearing his or her name, to be worn during the convention for the purpose of identification. The registration headquarters will be in the lobby of the Engineering Societies Building, and the members are earnestly requested to register themselves and their guests promptly on arrival.

Hotel Arrangements

As ample hotel accommodations are available in the neighborhood of Institute headquarters, no special hotel arrangements have been made. Members will therefore make their own hotel reservations.

Transportation

No special transportation rates are available. Members should, therefore, consult their local ticket agents regarding routes and rates. Parlor and sleeping car accommodations should be engaged in advance.

Secretary Hutchinson Convalescent

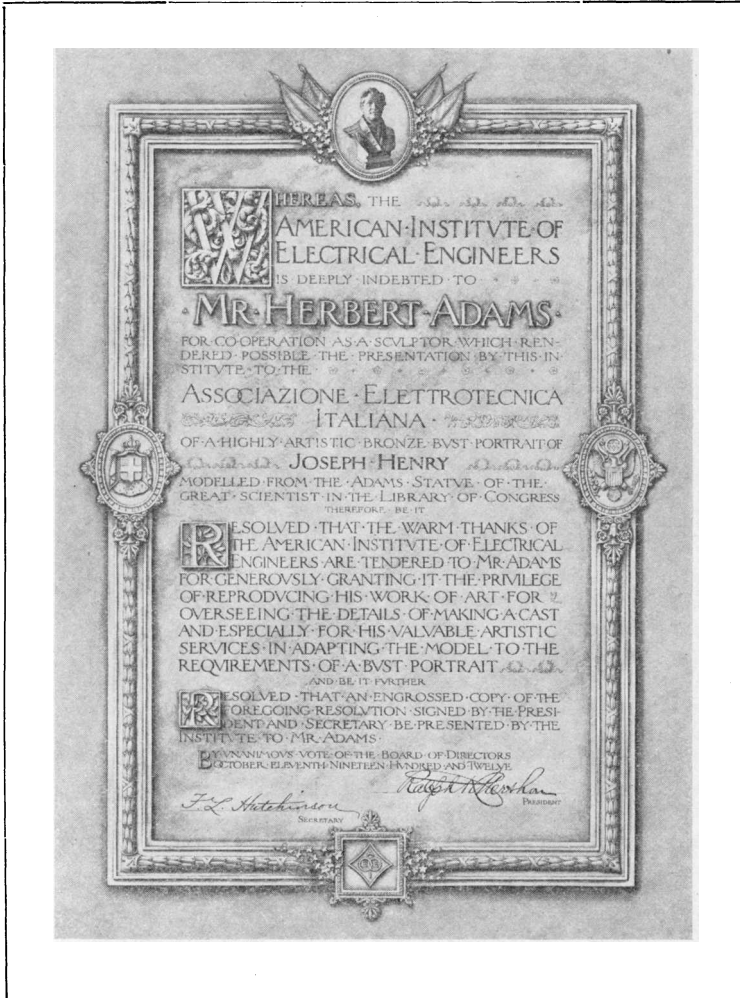
Since the issue of the January PROCEEDINGS, Secretary Hutchinson has left the hospital and is now regaining his normal condition. After spending a few days with his sisters at Elizabeth, N. J., he has gone to Atlantic City to recuperate, by advice of his physician. He hopes to resume his duties at the next meeting of the Board of Directors, on February 14.

Presentation to Mr. Herbert Adams of Engrossed Resolutions of Thanks

The day before Christmas, Mr. Herbert Adams was the guest of the Institute at a luncheon given in his honor at the Engineers' Club in New

York. The accompanying cut shows the resolutions as engrossed.

The actual presentation was made by Mr. C. O. Mailloux, chairman of the committee, who, in graceful words, emphasized the sincerity of the Insti-



York under the auspices of the Italian Memorial Committee. The occasion was the presentation to Mr. Adams of an engrossed copy of the special resolutions of thanks passed by unanimous vote of the Board of Directors in October.

tute's appreciation of all Mr. Adams had done. President Mershon then added to the good feeling which prevailed by making a few happy remarks.

In acknowledgment, Mr. Adams confessed to being deeply moved by

this additional proof of good will, and referred to his relations with the Institute as having been a source of great pleasure, the memory of which would always remain with him.

A. I. E. E. Lectures on Radioactivity

A series of lectures on radioactivity will be presented to the Institute by Professor Edwin P. Adams of the Palmer Physical Laboratory, Princeton University, on Tuesday evenings, March 18 and 25 and April 1 and 8, at 8:15 p.m. in the auditorium of the Engineering Building, 33 West 39th Street, New York.

These lectures will offer an unusual opportunity for engineers to obtain an insight into the nature of the phenomena which have been discovered in this most fascinating field of research. The discovery of radioactive substances and the study of their properties constitute probably the most important support of modern accepted theories of the nature of electricity and matter.

Professor Adams has consented in these lectures to present a general survey of the history and important results of research in radioactivity and the bearing of these results on modern electrical theory. They will aim to respond directly to the increasing demand from electrical engineers for a simple and comprehensive description of the phenomena of radioactivity. They will assume that the hearer has no present knowledge of the subject.

The conduct of the course of lectures is under the direction of the Electrophysics Committee of the Institute. The lectures will be open to the membership of the Institute. The members of the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Society of Civil Engineers, the Electrochemical Society and the Illuminating Engineering Society are also invited to attend the lectures.

Directors' Meeting January 10, 1913

The regular monthly meeting of the Board of Directors of the American Institute of Electrical Engineers was held in New York on Friday, January 10, 1913.

The Directors present were: Ralph D. Mershon, President, New York; Gano Dunn, Past-President, New York; David B. Rushmore, and Charles W. Stone, Schenectady, N. Y., W. G. Carlton, New York, A. W. Berresford, Milwaukee, Wis., W. S. Murray, New Haven, Conn., Severn D. Sprong, Brooklyn, N. Y., Vice-Presidents; H. H. Barnes, Jr., W. S. Rugg, Charles E. Scribner, and William McClellan, New York, F. S. Hunting, Ft. Wayne, Ind., J. Franklin Stevens, Philadelphia, Pa., Comfort A. Adams, Cambridge, Mass., Managers; George A. Hamilton, Treasurer; Ralph W. Pope, Acting Secretary.

The action of the Executive Committee in appointing Mr. Ralph W. Pope Acting Secretary during the illness of Secretary F. L. Hutchinson, was approved.

The Secretary announced the following committee appointments made by the President: Committee on Use of Electricity in Mines: George R. Wood, chairman, W. E. Moore, H. M. Warren, H. H. Clark, J. T. Jennings, W. A. Thomas, K. A. Pauly, C. T. Henderson, C. W. Goodale, L. S. Noble, William Kelly. Special Committee on Organization and Work of Technical Committees: H. G. Stott, chairman, H. W. Buck, H. S. Putnam, C. A. Adams, P. M. Lincoln. Representatives of the Institute upon the Library Board of the United Engineering Society: Samuel Sheldon, Frederick Bedell, Dugald C. Jackson, Malcolm MacLaren, F. L. Hutchinson. Executive Committee of Committee on Organization of International Electrical Congress: Charles F. Scott, first vice-president; the appointment of Mr. Scott followed the resignation from the committee of Mr. W. D. Weaver.

The Standards Committee reported

this additional proof of good will, and referred to his relations with the Institute as having been a source of great pleasure, the memory of which would always remain with him.

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The regular monthly meeting of the Board of Directors of the American Institute of Electrical Engineers was held in New York on Friday, January 10, 1913.

The Directors present were: Ralph D. Mershon, President, New York; Gano Dunn, Past-President, New York; David B. Rushmore, and Charles W. Stone, Schenectady, N. Y., W. G. Carlton, New York, A. W. Berresford, Milwaukee, Wis., W. S. Murray, New Haven, Conn., Severn D. Sprong, Brooklyn, N. Y., Vice-Presidents; H. H. Barnes, Jr., W. S. Rugg, Charles E. Scribner, and William McClellan, New York, F. S. Hunting, Ft. Wayne, Ind., J. Franklin Stevens, Philadelphia, Pa., Comfort A. Adams, Cambridge, Mass., Managers; George A. Hamilton, Treasurer; Ralph W. Pope, Acting Secretary.

The action of the Executive Committee in appointing Mr. Ralph W. Pope Acting Secretary during the illness of Secretary F. L. Hutchinson, was approved.

The Secretary announced the following committee appointments made by the President: Committee on Use of Electricity in Mines: George R. Wood, chairman, W. E. Moore, H. M. Warren, H. H. Clark, J. T. Jennings, W. A. Thomas, K. A. Pauly, C. T. Henderson, C. W. Goodale, L. S. Noble, William Kelly. Special Committee on Organization and Work of Technical Committees: H. G. Stott, chairman, H. W. Buck, H. S. Putnam, C. A. Adams, P. M. Lincoln. Representatives of the Institute upon the Library Board of the United Engineering Society: Samuel Sheldon, Frederick Bedell, Dugald C. Jackson, Malcolm MacLaren, F. L. Hutchinson. Executive Committee of Committee on Organization of International Electrical Congress: Charles F. Scott, first vice-president; the appointment of Mr. Scott followed the resignation from the committee of Mr. W. D. Weaver.

The Standards Committee reported

certain resolutions adopted at its meeting held on December 13, 1912, in conjunction with a special committee of the American Society of Mechanical Engineers, recommending the use of the term "myriawatt" as the unit of thermal or mechanical power in connection with boilers, producers, turbines and engines, and the discontinuation of the use of the term "boiler horse power." The committee further recommended the publication of the resolutions in the *PROCEEDINGS* and the technical press.

The Board approved the Standards Committee's recommendations both as to the use of the term "myriawatt" and the publication of the resolutions.

Chairman Rugg of the Meetings and Papers Committee announced that arrangements had been made for a series of four lectures to be delivered before the Institute by Professor E. P. Adams, of the Palmer Physical Laboratory, Princeton University, on Tuesday evening of each of the last two weeks in March and the first two weeks in April, under the auspices of the Electrophysics Committee.

The Board voted to give publicity to the lectures through the *PROCEEDINGS* and technical press, and to extend to the members of allied engineering societies, through their respective secretaries, an invitation to attend the lectures.

The Meetings and Papers Committee made an informal report regarding arrangements for the midwinter convention, which indicated that a large number of papers would be presented, and that the Standards Committee was engaged in perfecting the program.

Upon the recommendation of the Standards Committee the Secretary was instructed to communicate with the secretaries of other engineering societies, inviting their members to attend the sessions of the midwinter convention and to take part in the discussions.

Upon the recommendation of the Meetings and Papers Committee the Board voted to omit the February New

York meeting, in order that the committee could concentrate its efforts on the midwinter convention.

The action of the Finance Committee in approving monthly bills amounting to \$10,297.07 was ratified.

A communication was read from Professor W. F. Durand, chairman of the Conference Committee on the International Engineering Congress, San Francisco, 1915, stating that the local committee of the congress was being organized, and that it was desirable for the Institute to appoint its representatives on the committee at the earliest possible date. The President was authorized to appoint three representatives on the local committee.

Notice having been given to the Board by the secretary of the Board of Trustees of the United Engineering Society of the expiration, in the latter part of January, of the term of Mr. W. S. Rugg as a representative of the Institute upon the Board of Trustees, Mr. Charles E. Scribner was unanimously appointed to succeed Mr. Rugg upon this board, for the term of three years ending on the fourth Thursday in January, 1916, as provided in the by-laws of the United Engineering Society.

The Secretary announced that in accordance with Section 21 of the Institute by-laws President Mershon would automatically become a member of the John Fritz Medal Board of Award on the third Friday of January, vice Mr. Louis A. Ferguson, whose term expires on that date.

Upon the recommendation of the Board of Examiners 67 Associates were elected and eighty-one students were ordered enrolled.

The following Associates were transferred to the grade of Member: Charles R. Underhill, New Haven, Conn., Charles F. Conn, San Francisco, Cal. The following Members were transferred to the grade of Fellow: Alexander E. Keith, Chicago, Ill., Henry A. Lardner, San Francisco, Cal.

THE FORUM

Dedicated to the Discussion of Institute Affairs

CONSTITUTION OF THE INSTITUTE
To the membership of the A. I. E. E.:

I should like to be permitted to point out an error in the argument presented in the December issue of the PROCEEDINGS, bearing on the desirability of another revision of the Constitution of the Institute. I only ask such a privilege for the reason that I have been a member of several committees on the revision of the constitution, and was the chairman of the committee which prepared the constitution adopted in 1901, to which reference was made in the December issue.

The fallacy referred to is the seeming assumption that the present constitution is, and the previous constitutions were, mere "quilt" work, that the function of previous committees has been merely to patch up and not rewrite the instrument to be superseded. This misunderstanding is probably due to the practise of calling a new constitution an amendment to that superseded, in order to conform to the phraseology of the constitutional clause whereby authority is given to make changes, which clause, however, does not imply that quite a new document may not be substituted for the existing one.

For example, in preparing the constitution of 1901, a careful study was made of the organic law of all American and British professional bodies of prominence, which codes, in fact, largely served as models for the new constitution; and it was assumed that there was no restriction placed upon preparing a document bearing, if thought necessary, little resemblance to that to be "amended." I am not aware that any other understanding prevailed at the "revision" of 1907, and consequently, instead of the present constitution being a "quilt-work," with patches dating from 1885, 1892, 1894, 1896 and 1901, it will probably be found that it was written to represent as nearly as pos-

sible all of the then-existing conditions of which account should be taken.

If, therefore, the present constitution is now in any sense obsolete, it has become so only through changes of conditions which have occurred during the last few years.

The other argument offered for the desirability of a new constitution, namely, that the conduct of the Institute is handicapped by limitations imposed by the present instrument, is one involving a principle on which there may be considerable honest difference of opinion. One thing seems unquestionable—that the membership at large alone should decree any changes affecting in any degree the fundamental principles according to which the Institute should be conducted. The constitution is the organic law which should strictly limit the body to the purposes for which it is organized, and the function of the officers provided under it is solely to administer this law as they find it, or, if discovered to be deficient, to propose to the membership remediable changes. If anything, the constitution of 1907 was too lax in several particulars, as, for example, in not sufficiently guarding admission to the higher grade of membership, and in not limiting the manner in which the Board of Directors may commit the Institute on questions of industrial or other matters of policy having little or nothing to do with "the advancement of the theory and practise of electrical engineering and of the allied arts and sciences, and the maintenance of a high professional standing among its members." Of course, by amendment, this constitutional limit to the activities of the Institute may be formally extended to industrial matters, but to do so would in time lead without doubt to the formation of a new body limited in scope to that of a professional organization for the nurture of the electrical sciences

and arts regardless of the relations of these to a constantly shifting industrial situation.

Perhaps there may exist other reasons than those here considered which render desirable the rewriting of the constitution. It appears to the writer, however, to be the part of wisdom to adhere in any revision, and particularly in one undertaken at the present time, to the idea of a strictly guarded constitutional basis for all activities of the society, with the least possible allowance of latitude in the administration of this organic law. Should it be found upon investigation in detail that under present conditions a serious handicap is encountered through the existing method of amending the constitution, this could, to a large extent at least, be overcome by shortening the period in which a proposed amendment could be acted upon, that period being approached as nearly as can be to the time that at present is required to make a new by-law by action of the Board of Directors.

Though aside from the main object of this communication, reference might here be made to the desirability, on the grounds of professional propriety, of the elimination, in any future revision

of the constitution, of such industrial corporation appendages as "General Counsel" and "Law Committee." The Institute is little more than a corporation by courtesy, and in fact was incorporated only to acquire a legal status as a property owner. Such appendages of industrial and commercial corporations engaged in the fierce battle for dollars, serve, in the best sense, for the protection of their rights or, in the worst sense, for infringement on the rights of others; on the other hand, the Institute is subject to no menace against its constitutional purposes, and does not, of course, desire to profit from legal technicality in its conduct. On rare occasions, when it may be actually desirable to obtain legal advice, this could be secured in the same manner as when a professional man feels he should consult a lawyer. If the former more dignified and appropriate name of "Council" were substituted for "Board of Directors," the professional impropriety of the present legal adjuncts to the government of the Institute would stand out still more clearly.

W. D. WEAVER

Charlottesville, Va.,
December 30, 1912

Engineering and Efficiency*

By H. G. STOTT

Engineering has been defined by Tredgold as "the art of directing the great sources of power in nature for the use and convenience of man."

Efficiency may be defined as the art of obtaining the maximum output from the minimum input.

With these two definitions in mind, we will proceed to analyze the relations between the two, keeping in touch as much as possible with the work of our own times.

If we take our own branch of engineering, we will find that in its brief career of thirty years it has already been

subdivided into at least twenty distinct divisions.

Some of these branches of engineering do not make any claim to exist for the purpose of developing higher efficiency in the strictest sense of the word, but do exist for convenience, and owing to their convenience they have now become necessities.

Take telegraphy, for example; it is difficult (if we follow Tredgold's definition of engineering) to see any connection between telegraphy and efficiency, as we have defined it; and the same argument applies to telephony and many other branches of general engineering, such as sanitation, surveying and military engineering, etc.

We have all become so accustomed to

*Presented before the Schenectady Section, A. I. E. E., December 4, 1912.

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We have all become so accustomed to

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the use of the word "efficient" that instinctively we feel that, whilst the above illustrations may be true, yet *per se* these various branches of engineering may be carried on in a more or less efficient manner. This instinctive feeling is a recognition of the fact that our original definition of engineering was lacking in that it ignored the economic factor which now plays such an important part in the engineer's work.

The moment we recognize the economic factor, we immediately see that telegraphy and telephony are most highly efficient, as they save enormous amounts of time, and it is probably no exaggeration to say that the average business man's efficiency has been improved at least 10 per cent by their use, which virtually means that a man now can accomplish as much in ten years as he formerly did in eleven, when the telephone and telegraph did not exist. In the same way, the work of the sanitary engineer has resulted in opening up parts of the world which were formerly so deadly in character as to be almost impossible for the white races. Notable instances of this are the work of our sanitary engineers in Cuba and the Isthmus of Panama, which were formerly scourged by yellow fever and malaria; but now, thanks to the engineer's work, they are almost as healthy as our northern states.

There is another instance where the economic factor enters again; for the efficiency of the whole world is increased a little when we open up new territory for habitation by the human race.

The company with which the speaker is connected has been engaged in important work, which has also resulted in greatly increased efficiency through the use of sound engineering principles; and as many novel problems were encountered, a brief sketch of the more important may prove interesting.

The existing New York subway system was designed to carry a maximum of 400,000 passengers per day; but the growth of the city was so rapid that some means had to be taken to relieve

the intolerable congestion of the system. As a result of careful study, it was decided to lengthen the station platforms so as to accommodate six-car local trains and ten-car expresses in place of the original five- and eight-car trains. This, in itself, was no small problem, as traffic had to be maintained whilst all this construction work was going on; but fortunately this difficult feat in engineering was accomplished without accident.

Ten-car trains were run experimentally and it soon developed that numerous new problems were to be solved by the car equipment department. Cars which formerly behaved in a decorous manner developed alarming characteristics of the broncho when coupled in tens, and refused to stay hitched together when accelerating or retarding. Further study developed the fact that the standard form of draft gear was no longer suited to handle multiple-unit trains of the weight and power used in the subway, and that instead of having the usual lost motion between cars, it was essential that there be no lost motion. This meant the design of pneumatic draft gear of a novel type, which successfully met the requirement of no lost motion.

During the period of retardation the ten-car trains had also broken apart and a careful examination of the facts showed that the brakes were not being applied synchronously on all the cars, due to the time lag of the air in the train line. Electricity was brought into play at this point and a new type of electrically operated air valve was developed and substituted for the old air line, with highly satisfactory results.

The introduction of pneumatically operated center side doors gave rise to many difficult problems in the re-design of the original cars, but all these were successfully overcome.

In order to reduce the length of the stops at the station, a new system of signalling to the motorman was developed; all the doors were equipped with a simple and sturdy type of circuit switch

and all these switches were connected in series through a bell in the motor-man's cab. This accomplishes a two-fold purpose; first, giving the starting signal to the motorman the moment the doors are closed, and second, making sure that the train will not be started until *all* the doors are closed.

It also became imperative to shorten the interval between trains and this was accomplished by a re-arrangement of the signal system such as to permit an interval of less than three minutes, as originally operated.

In the motive power department we were confronted with a number of problems which called for solution in order to provide power for the operation of the additional cars and trains.

The low-tension feeder system was largely reinforced, and at points midway between substations circuit breakers were installed between each of the four contact rails and a common bus, so as to parallel the third rails and thus get the benefit of the conductivity of all the feeders to reduce the momentary drop during the brief periods of acceleration of the ten-car trains, when each one takes about 2600 kw. These tie-in circuit breakers are operated by air pressure and are controlled from the adjacent substations; being interlocked with feeder circuit breakers, each track can be isolated from the substation switchboard at a moment's notice, thus giving great flexibility to the low-tension system.

The substations had been designed so as to accomodate six or eight 1500-kw. synchronous converters, and as more power was required the problem was either how to get more converters in, or else how to install larger machines in the same space occupied by the 1500-kw. units. The first alternative was possible in some of the substations, but not in others, so the manufacturer was called in and requested to design as large a converter as the space would permit. This resulted in the development of a 3000-kw. unit and later, of an interpole converter capable of carrying a load of

4500 kw. for three hours and 10,000 kw. for one minute.

To illustrate the progress of the art, we can now obtain a unit which will occupy the same floor space as the original 1500-kw. machine, but with a steady rating of over 6000 kw. and 12,000-kw. rating for thirty seconds.

In the power plant it also became necessary to get additional capacity and several alternatives were considered, amongst them being the installation of the regular high-pressure turbine as a prime mover. If this course had been adopted, the existing high-grade engine-driven units would have been disposed of at the price of scrap, but fortunately an alternative in the shape of a low-pressure turbine was available, and this type of unit was installed in connection with five of the engine-driven units. The installation of these low-pressure machines resulted in some very important economies; first, they gave a new lease of life to their partners, the reciprocating units; second, they gave an increase of 100 per cent in the maximum capacity of the plant; third, an increase of 146 per cent in the economic capacity, and lastly, but not least, an improvement of 25 per cent in economy of the plant.

The result of all these improvements in the system was that the subway had the interval between trains cut down from three minutes to one minute and forty-eight seconds, or an improvement of 40 per cent; and the daily capacity was increased from 400,000 passengers to over 1,000,000 at the same time. This is surely an illustration of the relationship between engineering and efficiency.

However, we should not feel too much pride in our achievements, as a moment's consideration of the losses going on will speedily restore us to a feeling of proper humility.

The five large power plants in New York City consume approximately 3500 tons of coal per day and of this coal, costing approximately \$11,000, 60 per cent, or \$6,600 per day, is lost in the condenser. In effect, we are de-

liberately dumping \$2,370,000 per annum into the sea.

Again, of the total fuel burned under our boilers, only about an average of 15 per cent is available for useful work, so that out of our \$4,000,000 worth of fuel we waste \$3,400,000 per annum. These large power plants are probably at least three times as efficient as the average factory plant, so that instead of having an average thermal efficiency of 15 per cent, the average of the entire country is in all probability not to exceed 6 per cent.

It will never be possible to recover all the heat in our coal, but there is a wide enough margin between 6 per cent and 100 per cent to encourage our engineers in the hope that they may achieve fame and wealth by discovering some new means of conserving our supply of fuel.

In the meantime, the problem is largely an economic one, for we seem to reach a state in the art in about every decade where the saving of fuel, due to the installation of more efficient apparatus, more than offsets the destruction of capital caused by deliberately scrapping *good* machinery for the sake of more *efficient* machinery.

Four years ago, in a vainglorious moment, I attempted to improve upon Tredgold's definition of engineering, and now I feel that I must, in closing, make another attempt at a better definition, which will include efficiency:

Engineering—the art of obtaining the maximum return from the minimum expenditure, of capital and labor, or of the forces and materials of nature.

A. I. E. E. Meeting in New York, January 10, 1913

The two hundred and seventy-ninth meeting of the Institute was held in the auditorium of the Engineering Societies Building, New York, Friday evening, January 10, 1913.

President Ralph D. Mereshon called the meeting to order at 8:15 o'clock, and then turned the remainder of the technical session over to Mr. Henry G. Stott, chairman of the Power Station

Committee, under whose auspices the meeting was held.

Chairman Stott then called upon Mr. B. G. Lamme, the author of the paper of the evening, entitled *High-Speed Turbo-Generators—Designs and Limitations*. Mr. Lamme in presenting his paper gave a brief abstract of its objects and scope.

The paper was then discussed in detail by Chairman Stott and Messrs. Henry G. Reist, R. B. Williamson, Philip Torchio, Carl J. Fechheimer, William LeRoy Emmet, Paul M. Lincoln, Peter Junkersfeld, H. M. Hobart, W. L. Waters, Comfort A. Adams, and Allan B. Field. The technical session closed at 10:30 p.m. after much valuable discussion had been presented on the construction and limitations of various types of high-speed turbo-alternators. The members then adjourned to the Institute rooms on the tenth floor where the usual smoker was held.

Recommended for Transfer to the Grade of Member, January 2, 1913

The following Associates were recommended for transfer to the grade of Member by the Board of Examiners at its regular monthly meeting held on January 2, 1913. Any objection to these transfers should be filed at once with the Secretary:

HART, PERCY E., Estimating Engineer,
Canadian General Electric Co., Toronto, Ont.

STREET, GEORGE T., Electrical Superintendent, San Domingo Light & Power Co., Puerto Plata, S. D.

Transferred to Grade of Fellow, January 10, 1913.

The following were transferred to the grade of Fellow of the Institute at the meeting of the Board of Directors on January 10, 1913.

KEITH, ALEXANDER E., Chief Engineer, Automatic Electric Co., Chicago, Ill.

LARDNER, HENRY A., Manager, J. G. White & Co., San Francisco, Cal.