

TRANSACTIONS

OF

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

VOLUME 32—1910

THIS volume contains the papers and proceedings of The American Society of Mechanical Engineers for the year 1910, covering the thirty-first year of the Society's history. A record of the work of the year is given in the annual report of the Council, presented at the Annual Meeting of 1910.

The newly-elected President, George Westinghouse of Pittsburg, was introduced, as is customary, at the Annual Meeting of the Society in December 1909, an account of which appeared in Volume 31 of Transactions, covering the proceedings of 1909.

GEORGE WESTINGHOUSE

George Westinghouse, President of the Society for 1910, was born at Central Bridge, N. Y., October 6, 1846. His father was a manufacturer of agricultural machinery, and established works at Schenectady, which are still in operation. The younger Westinghouse was educated in the public schools and at Union College, Schenectady, and received his early mechanical training in his father's manufactory. His tastes were strongly in the direction of machinery and the solution of mechanical problems.

The patriotic ardor which filled the youth of the country during the Civil War drew young Westinghouse into the volunteer army in June 1863. He was under seventeen, but on account of his size and strength—he was six feet tall and weighed 180 pounds—the recruiting officers admitted him. In December 1864 he became an assistant engineer in the United States Navy, serving in that capacity until August 1865.

Returning to civil life he invented in the same year a device for replacing derailed cars, and while placing this invention with the railroads his attention was attracted by the prevalence of minor and serious accidents due to the lack of efficient means for controlling trains in motion. After a careful study of the subject, and such experiments as were possible with the limited means then obtainable, he invented the air brake and patented it in 1868.

The first train to which this brake was applied ran on a line west from Pittsburg and on what is now a portion of the Pennsylvania Railroad. During the trial trip a collision with a loaded team stuck on a grade-crossing was prevented. This practical illustration of the utility of the invention led to the adoption of the brake. Mr. Westinghouse, retaining the control of his invention, undertook to manufacture it and organized the Westinghouse Air Brake Company, establishing at Pittsburg the business which subsequently became the nucleus of the many industries associated with his name. He later applied compressed air to switching and signalling and utilized electricity in this connection. From this grew the Union Switch and Signal Company.

His introduction of electricity into switch and signal work led him far into electrical experiment and he devoted his energies to a cause in which few then believed, the adoption of the alternating current for lighting and power, in which he had to meet and overcome almost fanatical opposition, which in many States sought legislation against the use of the alternating current as dangerous to the public welfare. In 1885 he acquired the patents of Gaulard & Gibbs, and having undertaken a comprehensive study of the distribution and utilization of electrical currents in a large way, he personally devised apparatus and methods for the work, and gathered around him a group of men who were to become experts in the new electrical art. He also organized the electrical company which bears his name and undertook the development and manufacture of the induction motor which made practical the utilization of the alternating current for power purposes.

Following the discovery of natural gas in the Pittsburg region, Mr. Westinghouse devised a system for controlling the flow and for conveying the gas over long distances through pipe lines, thus supplying fuel to the homes and factories of Pittsburg. He took up the study of the gas engine, and for ten years conducted a series of exhaustive experiments in this line, at the end of that time putting into commercial use a gas engine of large power for electric generating.

Mr. Westinghouse introduced the Parsons steam-turbine into this country, adding to it improvements and developments of his own, and others carried out under his supervision. He has also recently developed a steam turbine for ship-propulsion designed to overcome the well-known objections to the use of turbines in that field, and lately coöperated with Rear-Admiral Geo. W. Melville and John H. Macalpine in their study of problems associated with driving of propellers at low speed by turbines of high speed.

It is impracticable to enumerate here the inventions which Mr. Westinghouse has personally made or those which his staff have brought forth under his supervision. As a result of this work and enterprise, there have grown thirty corporations of which he is president, employing 50,000 men, and \$120,000,000 of capital, with works at Wilmerding, East Pittsburg, Swissvale and Trafford City, Pa.; at Hamilton, Canada; London and Manchester, England; Havre, France; Vardo, Italy; and at Vienna and St. Petersburg.

Mr. Westinghouse has made many visits to Europe in connection with his inventions and industries. There as in his own country he has won the friendship of the foremost men of his time and the high esteem of the engineering profession. He has been decorated by the French Republic and by the sovereigns of Italy and Belgium; and he was the second recipient of the John Fritz Medal, Lord Kelvin, his friend of many years, having been the first. The Königlische Technische Hochschule of Berlin bestowed upon him the degree of Doctor of Engineering; and his own college, Union, gave him the degree of Ph.D. Besides his Honorary membership in The American Society of Mechanical Engineers, Mr. Westinghouse is one of the two honorary members of the American Association for the Advancement of Science and is an honorary member of the National Electric Light Association.

THE ANNUAL REPORTS OF THE COUNCIL AND STANDING COMMITTEES, 1910

THE REPORT OF THE COUNCIL

The Council presents the following summary of the activities of the Society, supplementing the reports of its Standing Committees, which are part of the report.

The Council has held nine meetings during the administration year, from December 1909 to December 1910.

HONORARY VICE-PRESIDENTS

In response to invitations representatives have been appointed on the following occasions:

National Civic Federation Conference on Uniform State Legislation, Washington, D. C., January 17-19

Jesse M. Smith, Chas. Kirchhoff, A. W. Burchard, E. G. Spilsbury, F. M. Whyte, Wm. H. Wiley.

Opening of the Forest Products Laboratory of the University of Wisconsin, Madison, June 4

Carl A. Johnson, J. G. D. Mack.

International Congress of Mining, Metallurgy, Applied Mechanics and Practical Geology, Düsseldorf, June 19-23

Charles Whiting Baker (also appointed from the Department of State as a delegate on the part of the United States).

Funeral of Charles T. Porter, Honorary Member, Auburn, N. Y., August 30

Alex. C. Humphreys, Hosea Webster, A. E. Forstall, J. E. McIntosh.

Second National Conservation Congress, St. Paul, Minn., September 5-9

Paul Doty, J. J. Flather, L. H. Gardner, E. E. Johnson, M. E. R. Toltz.

National Irrigation Congress, Pueblo, Colo., September 26-30

C. H. Williams.

American Mining Congress, Los Angeles, Cal., September 26-October 1

H. H. Clark, Robert Linton.

Inauguration of President McVey, University of North Dakota, September 27-29

Calvin H. Crouch.

MEMBERSHIP

The changes in membership are shown in the following table:

GRADE	No. Oct. 1, 1909	LOSSES				ADDITIONS		NET INCREASE	No. Oct. 1, 1910
		Trans- fer	Resig- nation	Lapsed	Death	Trans- fer	Elec- tion		
Honorary.....	15				1		1		15
Members	2483		13	13	31	28	155	126	2609
Associates	394	28	5	4	5	1	40	decrease	393
Juniors	834	1	16	20	1		86	48	882
Total.....	3726	29	34	37	38	29	282	173	3899
Affiliates of Gas Power Section.....									145
Affiliates of Student Branches.....								318	512

The following resignations were accepted during the year 1909-1910:

Edgmont B. Arnold, Jno. S. Avery, Richard C. Beverley, Albert E. Coleman, Asa S. Cook, Carl S. Dow, Harry Dunn, L. Hodgson, A. E. Holcomb, Zareh H. Kevorkian, George E. Kirk, Wellington W. Kuntz, W. A. McFarland, Henry E. Paine, R. Raymond, E. G. Rust, Foster C. Slade, Henry J. Scales, L. Searing, Ephraim Smith, J. E. Tatnall, Chas. J. Wachalofsky, Arthur S. Wardwell.

Membership which has lapsed during the year 1909-1910:

Arthur T. Alexander, Elmer T. Barnard, Wm. W. Bigelow, Frederick A. Boland, F. E. Bradenbaugh, James Breen, Jas. M. Briggs, E. D. Clarage, John G. Dodwell, Wm. F. Donovan, L. H. Gardner, Jos. N. Gregory, H. H. Hanna, Jr., Geo. O. Hodge, G. L. Holmes, Nathaniel Lombard, Chas. F. Meissner, E. E. Miller, John L. Mohun, Rafael de la Mora, James Naughten, Harvey E. Newell, W. Allen Pendry, H. W. Pudan, J. D. Ramsay, Warren B. Reed, Cyrus W. Robinson, D'A. W. Roper, Frederic Albert Schroeder, Edward Seaver, Jr., Robert M. Snyder, E. O. Spillman, George W. Stewart, Alfred A. Thresher, Chas. Henry Umstead, C. L. Weil, A. J. Wiechardt.

Members deceased during the year 1909-1910:

Mark Bary, Stephen Baldwin, Chas. Batchelor, Wm. P. Bettendorf, Jas. H. Blessing, J. H. Bloomberg, Jas. W. Bridge, Wm. W. Churchill, Chas. B. Clark, Wm. E. Crane, B. Cruikshank, Chas. B. Dudley, J. D. E. Duncan, R. W. Emerson, Jas. B. Faulks, Jr., C. F. Foster, Chas. H. Ferry, J. Garbett, A. M. Goodale, L. C. Grover, H. S. Haskins, Walter C. Kerr, John E. McKay, Wm. Metcalf, F. J. Plummer, Wm. N. Parsons, Chas. T. Porter, I. I. Redwood, P. A. Sanguinetti, T. H. Savery, Horace See, Gardner C. Sims, J. Henry Sirich, Jr., Wm. W. Snow, E. P. Sparrow, A. Spies, Chas. Swinscoe, C. H. Willcox.

On approval of the Membership Committee, John T. Jones and B. H. Cameron have been reinstated.

The Council has elected to Life Membership, S. B. Whiting and W. F. Mattes, who have been Members ever since the formation of the Society; and George W. Melville, Rear-Admiral, Past-President of the Society, has been made an Honorary Member.

On the Spring and Fall Ballots the following new members were elected and changes in grade of others authorized:

Elected June 1, 1910, Atlantic City: Members. W. J. Best, F. A. Blakeslee, Edward W. Brown, William L. Bryant, Henry Kenyon Burch, W. R. Carson, Cloyd M. Chapman, H. B. Chapman, Frank H. Clark, H. I. Cone, E. S. Cooley, E. H. Coster, A. D. Cressler, Byron Cummings, W. J. Davis, John A. Doane, D. Dorward, Jr., M. C. Ernsberger, R. W. Fenn, Harwood Frost, George W. Fuller, J. W. Fuller, Jr., David L. Gallup, Albert F. Ganz., Edwin S. Hallett, John Hays Hammond, W. H. Herschel, Alec. W. Hodgson, U. T. Holmes, F. Kingsley, A. Lebrecht, C. R. Lester, Wm. J. A. London, Harrison Loring, Jr., Chas. G. Lundgren, Adolphus A. McLeod, W. G. Marot, Irving S. Merrell, Frank H. Metcalf, John F. G. Miller, Lewis F. Moody, J. Wm. Neidhardt,

Henry B. Oatley, Harry L. Parr, A. C. Paulsmeier, C. H. Peterson, Hollis P. Porter, Snowden B. Redfield, George R. Sanford, Eugene Y. Sayer, R. Schlatter, John J. Scollan, F. L. Sessions, W. C. Shallcross, Joseph D. Shaw, Elmer A. Sperry, Edson M. Stevens, Eliot Sumner, Theodore S. Tenney, W. E. Van Patten, V. S. Westcott, W. H. Whiteside, R. M. Wiggins, Paul Winsor, E. W. Wyatt, Lucien I. Yeomans, S. J. Zowski-Zwierzchowski. Promotion to Members. P. H. Batten, Frank Bishop, Jos. A. Bursley, Carl F. Dietz, R. W. Emerson, F. L. Kennedy, Roy Stevenson King, Frederick W. Mahl, S. M. Marshall, H. E. Satterfield, C. D. Young, John M. Young. Associates. Frank Burgess, S. P. Cobb, H. N. Cooley, Frank M. Sears, O. C. Thompson, Charles N. Thorn, Lawrence Whitecomb. Promotion to Associates. Wm. P. Hawley, Louis G. Henes. Juniors. M. L. Abrahams, John Adams, Alex. D. Bailey, Geo. A. Bancroft, Arthur F. Barnes, C. M. Barron. E. H. Bedell, Richard O. Bonner, J. B. Brady, Walter E. Brown, A. Bradley Burgess, Harold Thomas Carter, T. D. Casserly, W. Van Alan Clark, H. H. Cook, William H. Cook, Glen H. Corlette, W. H. Correa, W. R. Crute, Geo. H. Cunningham, H. N. Davock, Ed. G. Dubarry, S. A. Ellenbogen, R. Emerson, H. V. Ennis, Stephen I. Fekete, J. O. Fisher, Walter J. Foley, George F. Gast, W. G. Gernandt, H. S. Gladfelder, Chas. C. Grant, Dwight K. Hall, H. D. Hartley, Fred M. Heidelberg, C. T. Henderson, Harry A. Hey, Warren B. Hood, C. M. Husted, Austin D. Keables, H. B. Lange, W. H. Lines, J. Harold McCreery, H. B. McKibben, Thos. B. Morris, S. T. Mudge, B. S. Nelson, J. G. Painter, John H. Peper, Jr., William T. Price, Rudolph Roesler, Philip L. Ross, D. D. Rowlands, R. L. Rowley, R. P. Schoenijahn, J. T. Sharp, Jr., E. J. J. Sievers, Charles O'Connor Sloane, N. L. Snow, W. C. Sprau, R. K. Stockwell, Everett W. Swartwout, H. B. Taylor, Gerald E. Terwilliger, Charles Thoma, Jr., Walter Thoma, L. B. Webster, James L. Wick, Jr., R. A. Wilson, Forest E. Woodman, A. R. Zachert,

Elected December 7, 1910, New York: Members. Lawrence Addicks, Will H. Baltzell, H. H. Barnes, Jr., Dwight K. Bartlett, Oliver D. H. Bentley, John C. Bird, George Wright Bowers, H. A. Brinkerhoff, Willard Brown, Forest E. Cardullo, J. D. Carr, Markham Cheever, Howard B. Clark, F. B. Cockburn, Arthur E. Cutler, Hans Dalstrand, W. R. Dunn, Charles L. Edgar, William J. Edwards, W. W. Erwin, Edmund H. Farquhar, John Fisher, Benjamin D. Fuller, Halbert P. Gillett, Philip M. Hammett, F. M. Hartman, J. R. Henderson, Chas. H. Herrick, Lewis A. Howland, Allen Hubbard, George Francis Hutchins, Chas. T. Hutchinson, A. L. Johnson, G. R. Joughins, O. F. Junggren, P. Junkersfeld, Karl W. Knorr, Gustav L. Kollberg, J. W. Ledoux, Norman Marshall, Frank Amedee Nazzur, Warren E. Murray, Walter S. Myers, Charles L. Norton, M. Webb Offutt, Francis Conrad Osborn, Oscar P. Ostergren, Perley Burnham Palmer, Geo. U. Poole, Edwin Jay Prindle, M. H. Putnam, Edward B. Richardson, Charles H. A. F. L. Ross, Will M. Sawdon, Phineas V. Stephens, Sidney Stevens, James Balboa Stokoe, Julian B. Strauss, Wm. Barrett Updegraff, E. Victoreen, G. R. Wadsworth, E. L. Walker, D. E. Washington, William P. Westcott, C. T. Westlake, Thos. R. Weymouth, Richard T. Wingo, John J. York; Promotion to Members. John H. Damon, James E. Gibson, Henry John Hanzlik, Arthur C. Jackson, Horace Judd, Wm. H. Kavanaugh, J. H. Maysilles, H. A. Moody, James A. Pratt, Geo. F. Read, Jr., Theodore Howard Taft, J. W. Taylor, J. G. Vincent,

F. H. Vose, H. L. Whittemore, L. L. Willard. Associates. Freeman Field, Emil J. Heinen, M. T. Maguire, Ray Mayhew, John B. Perkins, W. R. Porter, G. E. Richardson, Arthur C. Scott. Juniors. John F. Allison, Edward E. Ashley, Jr., H. Harding Bailey, W. J. Bailey, T. D. Banks, Henry C. Beckwith, Harry Lewis Benner, Myron R. Bowerman, Wm. Wallace Boyd, Harry S. Brown, R. U. Bunker, Herbert W. Carey, F. A. Collins, Jr., P. E. Cowgill, Magruder Craighead, Peter A. Cummins, Charles Iven Day, H. L. Doolittle, H. Alfred Ellis, John Fallon, W. W. Fisher, Arthur P. Gerry, Frank J. Gordon, Lucian L. Haas, H. F. Hallock, L. G. Hanmer, R. C. Hargreaves, Eugene Hunt, Frederick W. Ives, John R. James, Reid Jones, John P. Kottecamp, Milton Kraemer, Chas. H. Leaman, Nixon Lee, W. E. McCann, J. P. McJilton, W. R. McKinnon, C. H. Mount, John P. Mudd, Albin J. Nott, Harry Ottinger, H. H. Ramsey, John I. Rogers, Jr., James R. Rossman, Jr., Chris. A. Shearer, A. F. Sinclair, Harry St. Clair Spillman, Glegge Thomas, Robert H. Tift, Albert C. Townsend, Samuel K. Varnes, Joseph W. Wattles, 3rd, Erwin L. F. Weber, Hugo W. Weimer.

The Membership Committee have recommended this year for ballot 306 candidates, including 30 candidates for promotion, as compared with 339 last year, including 45 promotions. The general financial conditions prevailing in the country and the strictness with which the Committee is scrutinizing applications perhaps account for the slight falling off this year.

At the Spring Meeting amendments were adopted, the intent of which is to make the Associate grade no longer an intermediate grade between Member and Junior. These amendments appear in the report of the Constitution and By-Laws Committee.

STUDENT BRANCHES

The Council has been strict in its requirements for admission of Student Branches, and in general these are similar to those of the Carnegie Foundation for the Advancement of Teaching. There have been admitted to Student Membership since the last annual report, the University of Maine, Orono, Me., the University of Arkansas, Fayetteville, Ark., Yale University, New Haven, Conn., and Rensselaer Polytechnic Institute, Troy, N. Y.

PUBLIC RELATIONS COMMITTEE

An amendment to the Constitution was adopted at the Spring Meeting in Atlantic City which added the Public Relations Committee to the regular standing committees of the Society. The President appointed James M. Dodge, Past-President, Chairman, with associates, Robert W. Hunt, Past-President, Dugald C. Jackson, J. W. Lieb, Jr., Fred J. Miller. This committee will take up as one of its first

duties the report of the committee appointed by the Council to investigate the proposed bill before the legislature of the State of New York looking to the licensing of engineers.

The special committee consisted of Chas. Whiting Baker, Chairman, Leonard Waldo and Alfred Brooks Fry, and their investigations have brought out data on this in foreign countries.

PUBLICATIONS

Under the direction of the Publication Committee there have been issued twelve numbers of The Journal with approximately 2461 pages of text and 638 pages of advertising matter; and Volume 31 of the Transactions. The Year Book is now issued but once a year and combines the geographical and alphabetical lists formerly issued in January and July.

Fred R. Low has been appointed a member of the Publication Committee to serve the unexpired term of H. W. Spangler, resigned.

HOUSE COMMITTEE

The House Committee have completed the decoration of the rooms of the Society, including the Secretary's office. These improvements have received favorable comments from the members and others. The Society's rooms are now especially inviting and comfortable and offer a convenient place for making appointments.

LIBRARY

The Society has received 218 gifts of books during the year, 176 by purchase and 85 by exchange. By the coöperation of Founder Societies in the administration of the libraries of the three Founder Societies as one library and extending the benefits, it is hoped that in the near future a trained engineer and librarian may be engaged, looking also to possible coöperation with the New York Public Library when it moves to the new site near the Society headquarters.

MEETINGS

Meetings of the Society are now being conducted in four cities. The Committee on Meetings having extended the privileges of the membership in Boston and St. Louis, have arranged for meetings of the Society in the cities of San Francisco and New York which shall be uniform with the first-mentioned cities.

During the past year there have been held seven meetings in New York with an average attendance of 271; in St. Louis six meetings with an average attendance of 75; and in Boston six meetings, with an average attendance of 240, some of these in coöperation with other societies. At the inauguration of meetings in San Francisco the Committee on Meetings delegated the Secretary of the Society and the Chairman of the Committee on Meetings to be in attendance. Past-President Jesse M. Smith and the Secretary also attended a meeting in St. Louis during the year.

Two new committees have been appointed, one on Meetings in New York, Walter Rautenstrauch, Chairman, Fredk. A. Waldron, Treasurer, F. H. Colvin, Edward Van Winkle and Roy. V. Wright, thus not only making all meetings uniform but also giving the nucleus of an organization to care for the social features of the regular Annual Meeting in New York. A Committee on Economic Administration of Industrial Establishments is being organized which shall have general responsibility for developing papers and meetings on that subject.

RESEARCH COMMITTEE

The Research Committee have prepared a list of laboratories of the various technical schools of the country. In addition to the name and location of the laboratory, the data include the name of the director, the field of engineering for which the laboratory is equipped, a list of subjects already investigated, the published reports, and a statement of problems under investigation. The Committee also have under consideration the development of a standard by which to judge the performance of safety valves.

STANDARD FLANGES

H. G. Stott, A. M. Mattice, J. P. Sparrow, and Wm. Schwanhauser have been appointed a committee to coöperate with the National Steam and Hot Water Fitters Association leading to the adoption of a uniform standard for flanged and screwed cast-iron fittings.

IDENTIFICATION OF POWER HOUSE PIPING

The committee appointed to report on the subject of standardizing the pipe coloring for power houses, H. G. Stott, Chairman, H.

P. Norton, Wm. H. Bryan, I. E. Moulthrop and J. T. Whittlesey, advised the appointing of a special committee on the subject to establish at the earliest possible date a standard system of coloring. The same committee has been re-appointed for this work.

LAND FUND COMMITTEE

On the resignation of the former Land Fund Committee, a new committee was appointed by the Council, Worcester R. Warner, Chairman, C. N. Lauer, I. E. Moulthrop, Geo. A. Orrok, F. H. Stillman. An active campaign has been started to clear the indebtedness of the Society for its share in the land on which the Engineering Societies Building rests, and \$88,920.03 have been received to date, leaving \$85,765.03 to be raised.

FINANCE COMMITTEE

The Finance Committee have taken an active oversight of the financial affairs of the Society and too much credit cannot be given for their conscientious work.

On account of the fact that election to membership occurs at a different date from that of the beginning of the fiscal year, at the request of the Council the question of partial dues has been considered carefully, with the result that amendments have been adopted during the year and have become a working basis, as shown in the report of the Committee on Constitution and By-Laws.

CONSTITUTION AND BY-LAWS

Under the direction of the Committee on Constitution and By-Laws, the following amendments have been made to the Constitution, By-Laws and Rules:

C 10 An Associate shall be thirty years of age or over. He must have been so connected with some branch of engineering or science, or the arts, or industries, that the Council will consider him qualified to cooperate with engineers in the advancement of professional knowledge.

C 11 A Junior shall be twenty-one years of age or over. He must have had such engineering experience as will enable him to fill a responsible subordinate position in engineering work, or he must be a graduate of an engineering school. A person who is over thirty years of age shall not be eligible to membership in the Society as a Junior.

C 45 The Standing Committees of the Society to be appointed by the President shall be:

Finance Committee.
Committee on Meetings.
Publication Committee.
Membership Committee.
Library Committee.
House Committee.
Research Committee.
Public Relations Committee.

B 11 Each person elected to membership, except an Honorary Member, must subscribe to the Constitution, By-Laws, and Rules of the Society, and pay the initiation fee before he can receive a certificate of membership in the Society. Resignations from membership shall be presented to the Council for action.

B 16 The initiation fee and the annual dues for the first year shall be due and payable on the first day of the month following the date of the election of a Member, Associate or Junior. The annual dues for each ensuing year shall be due and payable in advance on the corresponding day in each year thereafter. Upon the payment of the initiation fee and the annual dues for the first year, the person elected shall be entitled to the rights and privileges of membership in the grade to which he was elected. The date of payment of a member's annual dues may be changed to the first day of any other month, and a pro rata adjustment of the dues made, by application to the Secretary.

B 17 A Member, Associate or Junior in arrears for dues for one year, on the first day of October previous to the Annual Meeting, shall not be entitled to vote, or to receive the Transactions or the publications issued by the Society thereafter until such dues have been paid. Should the arrears for dues or otherwise be for more than two years, the name of such person shall be presented to the Council for such action as it deems advisable under C 24. Should the right to vote, or to receive the publications of the Society be questioned, the books of the Society shall be conclusive evidence.

B 18 The Council may, in its discretion, restore to membership any person dropped from the rolls for non-payment of dues, or otherwise, upon such terms and conditions as it may at the time deem best for the interests of the Society.

B 22 The Finance Committee shall consist of five Members or Associates. The term of office of one Member of the Committee shall expire at the end of each Annual Meeting. This Committee shall, under the direction of the Council, have a supervision of the financial affairs of the society, including the books of account. The Committee may cause the accounts of the Society to be audited and approved annually by a chartered or other competent public accountant. The Committee shall hold monthly meetings for the audit of bills and such other business as shall come before it and shall deliver to the Secretary for representation to the Council at the end of each fiscal year, a

report of the financial condition of the Society for the past year, and also shall present therewith a detailed estimate for the probable income and expenditure of the Secretary for the following twelve months. It shall make recommendations to the Council as to investments, and when called upon by the Council, advise upon financial questions. It shall have charge of the making of all contracts and other obligations to pay money in the Society's work and the ordering of all expenditures thereunder.

B 24 The Publication Committee shall consist of five Members or Associates. The term of office of one Member shall expire at the end of each Annual Meeting. The Committee shall review all papers and discussions which have been presented at the meetings, and shall decide what papers and discussions, or parts of the same, shall be printed in the Transactions of the Society. The Committee shall have the supervision of the monthly publication of the Society known as "The Journal." The Committee will be expected to publish all such data as will be of assistance to engineers or investigators in their work. At the end of each fiscal year the Committee shall deliver to the Secretary for presentation to the Council a detailed report of its work.

B 37 The Annual Meeting shall begin in the City of New York on the first Tuesday in December and continue from day to day as the Council may direct.

The Annual Business Meeting of the Society shall be held on the Wednesday following the first Tuesday of December.

The Semi-Annual Meeting shall be held in such a place and begin on such a day as the Council may direct, and continue from day to day.

The Semi-Annual Business Meeting of the Society shall be held immediately preceding the first professional session of the Semi-Annual Meeting.

Professional meetings of the Society for the reading and discussion of papers and for topical discussions may be held at such times and places as the Council may direct.

Announcements of all meetings of the Society shall be published in The Journal.

A notice of each Annual and Semi-Annual Meeting and each Annual and Semi-Annual Business Meeting of the Society shall be mailed by the Secretary to each member in each grade not less than 30 days before the date of that meeting and at least 30 days before each Special Business Meeting.

R 24 Engineers and others not members of the American Society, but desiring to participate in the meeting of the Section, may enroll themselves as affiliates as heretofore provided with the approval of the Executive Committee of the Section. Such affiliates shall have the privilege of presenting papers and taking part in the discussions. They shall pay \$5 per annum which shall be due and payable in advance, on October 1 of each year of their enrollment, and shall thereby be entitled to receive the regular issues of The Journal for a period covered by their dues.

R 29 The American Society of Mechanical Engineers will furnish monthly issues of The Journal to all members of affiliated organizations who are not members of The American Society of Mechanical Engineers upon the pay-

ment by each of two dollars per year, such payment being due January 1 of each year. The American Society of Mechanical Engineers will furnish gratis to each affiliated body, extra copies of advance papers for use at its meetings, the number furnished to be agreed upon at the discretion of the Secretary.

R 35 The tellers of election in counting the ballots for officers shall consider the ballot for an officer as valid, provided the intent of the voter as to that particular office is clear, even though his ballot as to candidates for another office may for any reason be invalid.

A special committee appointed to report on improvements in the methods of balloting now in use in the Society, Theodore Stebbins, Chairman, W. T. Donnelly and Chas. E. Lucke, have made a report which is to be considered at a joint meeting of the committees interested.

MEETING IN ENGLAND

The Secretary and Honorary Secretary presented reports of the enjoyable trip to England and the meeting with The Institution of Mechanical Engineers. The former report is in narrative form while the latter treats of the significance of international meetings.

REPORT OF THE FINANCE COMMITTEE

After one of the most active years in the history of the Society your Committee is gratified in being able to present a financial report which indicates growth and prosperity financially as well as technically.

Although the current expenses of the Society were larger than in any time in its history, yet as will be seen from the appended reports the current income has met the expenses in full and has enabled us to cancel in this one year all of the extraordinary expenses up to date, due to the meeting with The Institution of Mechanical Engineers in England the past summer, and also to add to our surplus account. This has been made possible from the fact that our excess of income over expenses for the year was \$10,649.41.

It is also interesting to note that at the close of the fiscal year our entire surplus represented by property and accounts receivable was \$6433.56 greater than September 30, 1909.

The Committee regret to record that no specific results have been attained during the year just closed in the direction of reducing our mortgaged indebtedness. The total amount received during the past year to the credit of the land fund was not the equivalent of one-

fifth of the interest on the mortgage, thereby making it necessary to look elsewhere to meet this interest charge.

It seems to the Committee that there is an urgent necessity for a strong effort to reduce this mortgaged indebtedness materially each year until it is wiped out, and the interest money thereby is made available for the extension of our Society work.

Herewith are given the detailed statements of the financial condition of the Society, together with the reports of Peirce, Struss & Company, of New York, certified public accountants, who have audited the books and accounts, and also a statement of the condition of the various trust funds for the fiscal year.

PEIRCE, STRUSS & Co.
CERTIFIED PUBLIC ACCOUNTANTS
37 Wall Street, New York

October 26, 1910

MR. ARTHUR M. WAITT,
CHAIRMAN FINANCE COMMITTEE

Dear Sir:

In accordance with your instructions, we have audited the books and accounts of The American Society of Mechanical Engineers for the year ended September 30, 1910.

The results of this examination are presented in three exhibits, attached hereto, as follows:

Exhibit A Balance Sheet, September 30, 1910

Exhibit B Income and Expenses for the year ended September 30, 1910.

Exhibit C Receipts and Disbursements for year ended September 30, 1910.

We beg to present, attached hereto, our Certificate to the aforesaid exhibits.

Respectfully submitted,

PEIRCE, STRUSS & Co.

Certified Public Accountants

PEIRCE, STRUSS & Co.
CERTIFIED PUBLIC ACCOUNTANTS
37 Wall Street, New York

October 26, 1910

MR. ARTHUR M. WAITT,
CHAIRMAN FINANCE COMMITTEE

Dear Sir:

Having audited the books and accounts of The American Society of Mechanical Engineers for the year ended September 30, 1910, we hereby certify that the accompanying Balance Sheet is a true exhibit of its financial condition as of September 30, 1910, and that the attached statements of Income and Expenses, and Cash Receipts and Disbursements are correct.

PEIRCE, STRUSS & Co.

Certified Public Accountants

EXHIBIT A

BALANCE SHEET, SEPTEMBER 30, 1910

ASSETS

Equity in Societies Building (25 to 33 West 39th Street).....	\$353 346.62	
Equity one-third cost of land (25 to 33 West 39th Street).....	180 000.00	
		\$533 346.62
Library Books.....	13 000.00	
Furniture and Fixtures.....	5 000.00	
		18 000.00
New York City 3½% Bonds 1954 Par \$35,000.....	30 925.00	
Cash in Bank representing Trust Funds.....	11 356.59	
		42 281.59
Stores including plates and finished publications		11 623.03
Cash in Bank for general purposes.....	3 611.73	
Petty Cash on hand.....	250.00	
		3 861.73
Accounts Receivable		
Membership dues.....	9 554.50	
Initiation fees.....	540.00	
Sale of publications, advertising, etc.....	6 360.04	
		16 454.54
Advances account of land subscription fund.....		9 955.22
Advanced payments.....		1829.65
Total Assets.....		\$637 352.38

LIABILITIES

United Engineering Society (for cost of land).....		\$81 000.00
Funds		
Life Membership Fund.....	\$35 151.07	
Library Development Fund.....	4 902.71	
Weeks Legacy Fund.....	1 957.00	
Land Fund Subscriptions.....	223.88	
Subscriptions to Annual Meeting.....	46.93	
		42 281.59
Current Accounts Payable.....		2 652.33
Membership dues paid in advance.....	804.25	
Initiation fees paid in advance.....	75.00	
		879.25
Initiation fees uncollected.....		540.00
Appropriation available to complete Vol. 31 of Transactions.....		4 200.00
Reserve (Initiation fees).....		27 926.97
Surplus in property and accounts receivable.....		477 872.24
Total Liabilities.....		\$637 352.38

SOCIETY AFFAIRS

EXHIBIT B

INCOME AND EXPENSES FOR THE YEAR ENDED SEPTEMBER 30, 1910

INCOME

Membership dues.....	\$ 57 551.79	
Sales gross receipts	9 210.25	
Advertising receipts.....	24 230.26	
Interest and Discount.....	1 684.01	
		\$92 676.31

EXPENSES

Finance Committee Office Administration including Salaries.....	\$20 205.68	
Finance, United Engineering Society Assessments.....	4 500.00	
Finance, Miscellaneous.....	634.36	
		\$25 340.04
Membership Committee.....	2 350.49	
Increase of Membership Committee.....	2.70	
\$House Committee.....		1 089.16
Library Committee.....		2 491.46
Meetings Committee		
Annual Meeting.....	2 394.40	
Spring Meeting.....	2 028.72	
Monthly Meetings.....	3 416.92	
London Meeting.....	2 270.23	
		\$10 110.27
Publication Committee		
Advertising Section, The Journal	11 791.32	
Journal, except Advertising.....	18 527.88	
Year Book.....	2 748.73	
Revises.....	131.96	
Transactions Vol. 31.....	2 801.79	
		\$36 001.68
		\$77 385.80
Research Committee.....	100.76	
Thurston Memorial Committee.....	139.06	
Sales Expenditures.....	4 401.28	
Total.....		\$82 026.90
*Excess of Income over Expenses.....		10 649.41
		\$92 676.31

\$From Current Income.....\$1 089.16
 Reserve Fund.....3 000.00

Total Expenses.....\$4 089.16

*Of this amount \$4200.00 is reserved to complete Vol. 31 of Transactions.

EXHIBIT C

RECEIPTS AND DISBURSEMENTS FOR YEAR ENDED SEPTEMBER 30, 1910

RECEIPTS

Membership dues.....	\$49 888.25
Initiation fees.....	6 345.00
Membership dues and initiation fees paid in advance.....	948.00
Sales of publications, badges, advertising, etc....	31 733.56
Subscriptions to Land Fund.....	616.00
Subscriptions to Expense of Annual Meeting.....	360.20
Interest.....	2 168.23

\$92 059.24

Cash in Banks and on hand, September 30, 1909..	20 613.22
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\$112 672.46

DISBURSEMENTS

Disbursements for general purpose.....	94 214.14
Interest on Mortgage on Land.....	3 240.00

97 454.14

Cash in Banks and on hand, September 30, 1910	15 218.32
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\$112 672.46

LAND FUND

RECEIPTS

Subscription.....	\$71 662.76
Interest.....	573.56
Advances from Society.....	9 955.22
Property, 12 W. 31st St.....	63 000.00

\$145 191.54

DISBURSEMENTS

Acquisition of property.....	7 971.11
Mortgage.....	99 000.00
Interest.....	27 766.92
Furnishings and equipment.....	7 671.81
Occupancy building, moving library.....	2 171.06
Expenses of Committee.....	386.76
Cash on hand.....	223.88

145 191.54

\$223.88

SOCIETY AFFAIRS

Cash on hand.....	223.88	
To be raised.....	90 731.34	
	90 955.22	
Amount of mortgage.....	81 000.00	
Advances by Society.....	9 955.22	
	90 955.22	

LIFE MEMBERSHIP FUND

Number of Life Members.....	90	
Number of Life Associates.....	6	
Number of Life Juniors.....	1	
	97	

97 Members at \$15 = \$1455

4 per cent interest on \$35,151.07 and credited to

unappropriated revenue..... \$1 406.04

Amount Oct. 1, 1910..... 35 151.07 35 151.07

LIBRARY DEVELOPMENT FUND

Amount Oct. 1, 1909.....	4 902.71	
Balance Oct. 9, 1910.....		4 902.71

WEEKS LEGACY

Amount Oct. 1, 1909.....	1 957.00	
Balance Oct. 1, 1910.....		1 957.00

THURSTON MEMORIAL FUND

Subscriptions.....	788.32	
Interest.....	36.47	
Current Income 1909-1910.....	139.06	
	963.85	

Expenditures

Bronze Memorial.....	850.00	
Reflector bracket.....	30.00	
Booklet.....	32.04	
Committee expenses.....	51.85	
	963.85	

ANNUAL MEETING SUBSCRIPTION

Balance in the hands of the Local Committee and held by the Society in trust.....	46.93	
	\$42 281.59	

The Committee also submit herewith as called for by the By-Laws a detailed estimate of the probable income and expenditure of the Society for the ensuing fiscal year:

ESTIMATE OF INCOME 1910-1911

Dues.....	\$57 525
Sales, gross receipts.....	5 000
Interest and discount.....	475
Advertising.....	25 500
	\$88 500

ESTIMATE OF EXPENSES 1910-1911

	FROM CURRENT INCOME	FROM RESERVE
Finance Committee.....	\$28 740	
Membership Committee.....	2 450	
Increase Membership Committee.....	500	
House Committee.....	600	\$ 400
Library Committee.....	4 500	
Meetings Committee.....	9 000	
Publication Committee.....	36 400	*1 500
Research Committee.....	300	
Public Relations Committee.....	100	
Committee on Power Tests.....	300	
Sales Expenditure.....	3 000	
Reserve Fund.....	600	
	\$86 490	\$1 900

Respectfully submitted,

ARTHUR M. WAITT, *Chairman*

R. M. DIXON

E. F. SCHNUCK

W. M. MARSHALL

G. W. ROBERTS

*Finance
Committee*

REPORT OF THE HOUSE COMMITTEE

Your Committee during the year has completed the work embodied in the decorative scheme outlined in its last report. This included the tinting of the walls and the furnishing of new carpets, new

* Advanced on account meeting in England to be paid out of current income.

draperies and new furniture in the entrance hall, Council room and library. It is felt that these rooms now present an attractive, quiet and dignified appearance appropriate to the home of the Society.

Your Committee also acquired a uniform series of photographs of all the Past-Presidents, which are now hung upon the walls of the library.

Your Committee has in mind the extension of its original program with a view to unifying the plan of decoration in such of the rooms as are open to the general public, and hopes to carry out these plans during the coming year.

Your committee further proposes to secure photographs of the Honorary Members, to be framed in conformity with the photographs of the Past-Presidents already hung upon the walls.

Respectfully submitted,

WILLIAM C. DICKERMAN, <i>Chairman</i>	} <i>House Committee</i>
BERNARD V. SWENSON	
FRANCIS BLOSSOM	
EDWARD VAN WINKLE	
H. R. COBLEIGH	

REPORT OF THE LIBRARY COMMITTEE

No radical changes have been effected in the library organization during the past administration year.

The libraries of the three Founder Societies are being operated in parallel, the actual library work being handled jointly by the library staff and the administration of the libraries being conducted under an informal Library Conference Committee consisting of the chairmen of the library committees of the Founder Societies.

It is expected that more intimate relationships between the libraries will be established in the near future.

It is also expected that the United Engineering Societies' library will be organized and that gifts of libraries and books may be received by it where they are not made a specific donation to the library of one of the Founder Societies.

The number of visitors accommodated at the library shows a continued increase as indicated by the following tabulations:

	Day	Night	Total
July.....	609	Closed	609
August.....	560	Closed	560
September.....	596	261	857

	1765	261	2026
Night.....	261		

Total.....	2026
------------	------

	1908		1909		1910	
	Day	Night	Day	Night	Day	Night
January.....	541	148	485	250	460	286
February.....	439	241	533	254	416	232
March.....	417	203	535	280	439	256
April.....	403	210	529	217	488	274
May.....	400	196	462	221	454	279
June.....	419	136	484	198	471	239
July.....	441	closed	472	closed	609	closed
August.....	362	closed	472	closed	560	closed
September.....	393	125	434	220	596	261
October.....	381	180	471	238		
November.....	435	200	479	223		
December.....	520	441	545	301		
	5151	2080	5901	2402	4493	1827

Membership cards received:

American Institute Electrical Engineers.....	10
American Society Mechanical Engineers.....	8
American Institute Mining Engineers.....	20
Non-members.....	8

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As an indication of the range of subjects called for by visitors to the library and the relative frequency of consultation, the following table may be of interest, covering the months of April-September 1910:

	Apr.	May	June	July	Aug.	Sept.
Architecture.....	1	2	1		1	1
Bibliography.....						2
Biography.....	1				1	1
Chemical Technology.....	4	5	4	2	3	1
Chemistry.....	4	4	2	1	2	2
Civil Engineering.....	7	1	5	2	2	5
Description and Travel.....	1	1	1	1		
Electrical Engineering.....	17	12	22	6	20	14

	Apr.	May	June	July	Aug.	Sept.
Electricity.....	2	9	1	5	5	1
Engineering(General).....	5	6	14	5	10	10
Geology.....	22	9	10	7	24	20
Hydraulic Engineering.....	2	3	4	2		10
Mathematics.....	5		1	1		9
Marine Engineering.....						
Mechanical Engineering.....	27	23	26	13	16	19
Metallurgy.....	14	4	11	13	4	1
Mining Engineering.....	16	11	20	9	9	6
Miscellaneous.....	1		3	4	1	4
Periodicals.....	49	28	89	30	39	90
Physics.....	7	2	2	3		7
Railroad Engineering.....		5		1		5
Railroad Engineering (Electrical).....	1					7
	196	125	216	105	137	215

It has been felt that the appropriation available for the purchase of new books is inadequate to keep the library supplied with the latest books of reference.

The amount expended for books and periodicals in 1908 was \$527.76. An approximately similar amount will be expended during the current year and your Committee in presenting its request for the appropriations for next year has submitted a request that the appropriation under this head be increased to \$1500.

Your Committee has in preparation a book plate for the Society's library which will be submitted for the approval of the Council of the Society at an early date.

Respectfully submitted,

J. W. LIEB, JR., *Chairman*

AMBROSE SWASEY

LEONARD WALDO

CHAS. L. CLARKE

ALFRED NOBLE

*Library Com-
mittee*

REPORT OF THE COMMITTEE ON MEETINGS

In addition to the Annual and Spring Meetings of the Society, 18 meetings have been held, six being held in each of the cities of New York, Boston and St. Louis. During 1911 meetings will also be held in San Francisco. At a number of these meetings sister societies and local engineering organizations coöperated, but the number of meetings given does not include those of other societies in which we coöperated.

It is the policy of your committee to meet weekly, excepting during the summer months, and including special meetings the Committee has practically carried out this policy during the period mentioned.

Fifty-four papers and three topical discussions have been accepted and published in *The Journal*, all of which have been or will come before meetings of the Society. These include eight papers presented at the meetings held at Birmingham and London.

Several cities other than New York, Boston, St. Louis and San Francisco are contemplating holding meetings, but they have not as yet reached a definite conclusion.

It has been suggested that appropriations be assigned for meetings, based on the number of members accessible to a locality. For the present, however, your Committee believes that the Society should do all possible to assist the membership in different localities in which these meetings are being held, to the limit of the available funds.

Your Committee finds that the local conditions vary at the different points and therefore repeats the suggestion contained in its report to the Executive Committee of May 31, 1910, that after more extensive experience of all the local committees on meetings has been obtained, they, in coöperation with the Committee on Meetings, formulate such rules as may be found necessary to establish uniformity in the conduct of all local meetings, the same to be subject to the approval of the Council.

A meeting of the local members in New York was held October 31, 1910, for the recommendation of names for a local committee, that New York City may be organized on the same basis as all other localities. It is intended that this committee, by the selection of some 20 assistants, shall also act as the entertainment committee for the Annual Meeting.

Your Committee has felt for some time that the papers presented before the Society have not been sufficiently diversified. It believes that it has overcome this to some extent, but with the further object of making the Transactions of the Society a more complete record of mechanical engineering progress, a circular has been mailed to the membership calling their attention to this point, which it is believed will result in materially increasing the value of the Transactions of the Society as a record of engineering progress. The attention given the circular so far is most gratifying and the membership is to be congratulated upon the interest it has inspired.

The rapid growth of industrial establishments has developed a

phase of mechanical engineering—that of economic administration—which your Committee feels should be given the attention by the Society that its importance warrants. This branch of the profession has evolved the administrative engineer until a very large percentage of the profession and of our membership is now occupying administrative positions in industrial establishments. Your Committee has had this question under attention for some time, but until recently it did not feel that the opportune time for definite action had arrived.

At its meeting, October 7, 1910, it requested the endorsement by the Council of the appointment of a sub-committee on the Economic Administration of Industrial Establishments. The committee is glad to have the Council's approval of its request and believes the field covered by this sub-committee can be made one of the greatest factors in our economic welfare.

Permit the Committee again to call the Council's attention to the recommendation that it feels the best interests of the Society would be subserved by a closer working arrangement between the Research Committee and the Committee on Meetings.

The Committee begs to thank the officers of the Society and the members of the office staff for the coöperation and assistance it has received.

Respectfully submitted,

WILLIS E. HALL, *Chairman*

WM. H. BRYAN

L. R. POMEROY

CHAS. E. LUCKE

H. DE B. PARSONS

*Meetings
Committee*

REPORT OF THE MEMBERSHIP COMMITTEE

During the current year the Membership Committee has held six meetings, at which the total of 337 applications for membership have been considered with the following results:

Withdrawn for various causes.....	14
Deferred indefinitely.....	17
Recommended for membership.....	306

Of the 306 names recommended for ballot 276 were candidates for new membership and 30 were candidates for promotion. The candidates recommended were voted for on two ballots submitted to the membership as follows:

Spring ballot.....	159
Fall ballot.....	147

The small number of names deferred and the fact that no objections have been received to the names placed upon the professional service sheets testifies to the increasing care taken by the members in filling out the application blanks, and to the careful manner in which all cases are studied in the Secretary's office before being submitted to the committee. The Committee, however, would emphasize again that its work will be greatly facilitated and the standards of the Society safeguarded if members will agree to act as proposers and seconders of an applicant only when they can support the latter through personal knowledge of his work.

The Committee desires to report that the new rules regarding the Junior and the Associate membership grades put into effect at the Spring Meeting, have operated upon the whole in a very satisfactory manner, and in the judgment of the Committee have placed the classes of membership upon a basis that makes for the best interests of the Society.

The Committee would recommend that it be given authority to prepare a list of approved engineering schools that will be used to interpret the phrase "engineering schools" in clause C 11 of the Constitution relating to the admission of Junior members.

Respectfully submitted,

C. R. RICHARDS, *Chairman*

GEORGE J. FORAN

THEODORE STEBBINS

FRANCIS H. STILLMAN

HOSEA WEBSTER

} *Membership
Committee*

REPORT OF THE PUBLICATION COMMITTEE

The Committee has had to meet the constantly growing number and length of papers presented to the Society by the members at its annual and monthly meetings by a very careful elimination or condensation of everything which might be termed extraneous or superfluous in order to keep within the confines of a single volume of the Transactions.

Volume 31, for 1909, just issued, contains 1069 pages and the current Volume 32 embracing, in addition to the Society papers the papers presented at the English meeting, will contain between 1500 and 2000 pages. This would be considered the outside limit of size.

The largest volume heretofore printed was No. 24 for 1903 which contained 1563 pages and was thought unwieldy, and yet if the growth of our available matter continues at anything like its present rate, we will be confronted with the necessity of binding the Transactions in volumes of about this size. An alternative would be the omission of the printing of the Transactions altogether as such, thereby avoiding the duplication of 75 per cent of the reading matter of The Journal.

This would be done by printing in The Journal previous to meetings a list only of the papers which will be read at the meeting, requesting members who desire to discuss any particular paper to send for a copy of it. After the meeting, The Journal would publish all papers with all discussions and at the end of the year would supply binders in which all copies of The Journal may be bound. This volume would continue the present series of the Transactions. By this means the papers would be printed once only instead of twice and the annual saving to the Society would be approximately \$5000, which could be applied to making the Library more accessible to members.

Previous to this year, The Journal has been published monthly, except in July and August when there were no issues, and in October and November to accommodate the additional amount of matter necessitated by the Annual Meeting it has appeared semi-monthly. This year, however, the arrangement has been changed so as to have it appear monthly throughout the year.

The gross and net cost of issuing the Society publications is given in the following tables for each of the past five fiscal years ending September 30.

EXPENDITURES

	1906-1907	1907-1908	1908-1909	1909-1910	1910-1911
History.....		\$ 95.06	43.65		
Revised papers.....		182.56	523.93	131.96	300
Year Book and Pocket List.....	2 232.35	2 622.57	3 000.89	2 748.73	3 200
Transactions.....	8 400.20	6 100.00	6 533.87	7 001.79*	8 600
The Journal.....	11 487.98	8 425.58	20 160.86	30 319.20	25 800
	22 120.53	17 425.77	30 263.20	40 201.68†	37 900

INCOME

Advertising.....			11 997.50	24 227.26	25 500
Appropriations.....	22 120.53	17 425.77	18 265.70	15 974.42	12 400

* Approximate.

† Estimated.

It will be seen that the net cost to the Society is gradually being lessened; the slight increase for 1908-1909 being due to the change in the issue of both the Year Book and the Pocket List to a combination of the two in one.

There has never been a complete cross-reference index of the Transactions, and there has been for a long time a crying need for one. Recently the Library Committee has had in mind the indexing of the Transactions of all the societies and it will be necessary to carry out a complete indexing of our Transactions in this connection. The Committee is now in conference with the Library Committee on the best method of coöperation in this work.

Respectfully submitted,

D. S. JACOBUS, <i>Chairman</i>	} <i>Publication Committee</i>
H. F. J. PORTER	
FRED R. LOW	
GEO. I. ROCKWOOD	
GEO. M. BASFORD	

REPORT OF THE RESEARCH COMMITTEE

The last formal meeting of the Research Committee was held December 10, 1909. At that meeting it was agreed that it would be unwise for the Committee to enter at once upon the investigation of problems of research. It was agreed that as a preliminary to actual work there should be on file in the office of the Secretary, a complete list of the college, commercial and other laboratories of the country, the organization of which might permit them to do work in line with the purposes of our Society. In addition to the name and the location of the laboratory, it was proposed to have the name and address of its director and a statement concerning the extent of its staff and equipment, also a list of the subjects which have been investigated and a reference as to where the reports thereof may be found, a statement of the problems now under investigation, and a statement of the field of engineering for which the laboratories are especially equipped. The circulars which have been sent out have been worded so as to make it clear that the Committee does not wish to intrude itself upon the activities of any laboratory, but that the inquiry grows out of a desire on the part of the representatives of a national organization to know how thoroughly the field is now covered. The responsibility for sending out these circulars and for tabulating the information obtained was left with the Secretary of the Society.

It is the understanding of your Committee that the work of gathering this information is now practically complete, and that there is on record in the Secretary's office all information along this line.

It was also agreed that the Committee might properly undertake a research concerning the performance of safety valves, and a circular has been issued designed to develop the most important facts which should be determined concerning the action of such valves. These were sent to 68 safety-valve manufacturers, to 125 railroads of 100 miles or over, and to three large boiler manufacturers. Forty-one replies have been received. Eighteen have no information regarding pop safety valves. Nine of the replies are of especial interest and have been abstracted as follows:

The Consolidated Safety Valve Company refers to Mr. Philip Darling's paper before the Society in 1909 and to experiments of Professor Miller of the Massachusetts Institute of Technology. They favor a high lift for steam passage. As to the rating of the various sizes they favor the continuation and duplication of the Darling and Miller tests. Nickel bronze is favored for valve seats and copper bronze with 10 per cent tin for valves. To maintain efficiency they favor keeping the exhaust steam away from the spring, and exposure to air currents for cooling. They consider the aperture has little effect on the capacity but is an important element of the lift. They suggest experiments to develop the effect of temperature and of steady loads and rapidly varying loads, on springs, also a study of the various rules governing sizes and design of various supervising authorities with the aim of developing a safe and uniform rule, applicable to all sizes. They suggest that many common faults of safety valves be made the subject of reports in boiler inspection service. Railroads which have a system of report covering engine failures might also outline the most common troubles with safety valves.

The Ashton Valve Company refers to the tests of Professor Miller, of the Massachusetts Institute of Technology. They favor the low lift from a practical standpoint with 30 years experience. They suggest tests determining a proper rating of safety-valve boiler based on the capacity of relief that the valve should give. They favor high grade composition of bronze metal made of copper and tin about 8 to 1. Regarding efficiency they make outside spring valve with spring free from steam exposure for use where steam temperature is over 400 deg. Fahr. As to aperture bevel seat valves 45 deg. angle give best results. Regarding additional facts they express the opinion that it will be difficult to establish a rule adaptable to both stationary and locomotive boilers and they discuss this point at length.

Crane Company know of no reliable data regarding discharge but refer to A. J. Hewling's discussion, in *The Journal, Am. Soc. M. E.*, June 1909. They are willing to submit valves and take part in public tests in order that reliable data may be had. They favor high grade composition of valve and valve seats and state that they have no experience of springs losing temper. Facts about the effect of the shape of the apertures have led them to adopt a cushion disc and spring which allows the highest lift practicable. As to tests they

suggest that the committee provide accommodations where safety valves may be tested under the same conditions and under most careful observation.

The Lunkenheimer Company do not know of any accurate data other than manufacturers' tests. They favor a lift of $\frac{1}{8}$ in. to $\frac{1}{4}$ in. They suggest time tests to determine the efficiency and lift of valves with various lifts under a wide range of actual service conditions and pressures. They favor nickel bronze composition, high percentage of nickel for the seat and a high grade steam metal for the disc. The outside spring type of valve is used to avoid undue heat and to maintain the efficiency. As to the shape of the aperture, they suggest six points to be considered. For research they suggest the evolution of a simple and practical rule for determining sizes based on a moderate constant lift.

Crosby Steam Gage and Valve Company have submitted a reply of some thirty pages accompanied by illustrations and catalogues. For data they refer to the Annual Report of the U. S. Steamboat Inspectors, 1877; thesis of Bardsley and Miller, Case School of Applied Science, 1906, data of tests referred to in Steam Boilers by Professor Peabody, p. 240; and tests now being made at Massachusetts Institute of Technology, 1910. Regarding the lift in safety valves they cite the experience of manufacturers' measurements at factories and in actual service; measurements made at the Massachusetts Institute of Technology, 1909. They suggest fixing standard or limits of lift, to insure durability of valves; measuring discharge of various designs of valves at same fixed lifts; reporting minimum lift and discharge which have been ample in past; and defining characteristics of operation most desirable in safety valves. They favor bronze composition, high percentage of tin, low in zinc and lead; nickel composition not to be endorsed. Exposing springs outside of valve body involves friction; encasing spring in inner chamber involves sticking; long spindles, large valve casings, well drained spring chambers essential without sliding contacts. Regarding open shape of aperture, see tests of Massachusetts Institute of Technology in "Steam Boilers" by Professor Peabody; also tests in progress at Massachusetts Institute of Technology, 1910; also Kent's Pocketbook, p. 724. For research they suggest verbal explanation in detail of essential characteristics of design of each valve as made; of the general principles involved, and defense of engineering reasons, advantages and objections governing each detail; in other words, the engineering "confession of faith" of each manufacturer and his own exegesis of each article of it.

Rock Island Lines: W. A. Nettleton knows of no boiler being blown up because the safety valve fails to properly relieve. Statistics of Mr. Curtis of the Master Mechanics Association Committee indicate very few boilers explode from over pressure, the majority explode from low water, due generally to carelessness. This applies to locomotive service in which the boiler is very closely watched. As to the durability, a number of small valves are preferable to a very large one. He is skeptical regarding the tendency towards a higher lift. He has had no experience as to temper of the spring and steam. He assumes the spring loses elasticity because of repeated strains.

Canadian Pacific Railway Company: Mr. Vaughan, Vice-President, considers it desirable to investigate for flat seats and V-shaped seats the amount of steam flowing per hour with different heights of lift, the height to which valves now in use lift with given increments of pressure, the effect of various forms of coupling devices based on the pressure between the seat of the valve

and the muffler; so as to obtain data on which to base a specification providing that a given diameter should have a lift of not less than a certain amount with a given increment of pressure between the seat of the valve, that there should be not more than a certain amount of pressure between the seat and the muffling device, that the area through the muffling device should bear a certain proportion to the area of the valve.

Babcock and Wilcox Company: Mr. F. A. Scheffler refers to the formula on p. 9, 1910 catalogue of the Consolidated Safety Valve Company, based on valves having 45 deg. beveled seat and actual evaporation tests. He states that complete data can be obtained from this company and also from the Naval Experimental Station, Annapolis, Md. He favors composition seats having at least 25 per cent nickel. Regarding deterioration, he states that a well-designed spring of good quality spring steel should not lose temper under saturated steam, and that an exposed spring design should be used under superheated steam. Very complete information has been published by the Consolidated Safety Valve Company in their book entitled Safety Valve Capacity.

Heine Safety Boiler Company: Col. E. D. Meier writes that experimental data are mainly in the possession of various firms and companies which manufacture high class valves, and cites the Consolidated Company, the Ashcroft Company and the Ashton Company, who have recently installed a boiler suitable for 400 lb. pressure for continuing such experiments. He states that the rules promulgated by various officials and societies seem to be based on experiments made at lower pressure than current practice. These rules may be deficient because action of metals under higher stresses and higher temperature will be different than in the early experiments. Mr. Geo. H. Musgrave has had some experience as a pioneer and is an enthusiast on the subject. There is great need of experimental work and the only safe way for a scientific settlement of these questions would be tests on entirely neutral grounds, i.e., in the laboratory of some well equipped mechanical engineering school of high repute. His company has to conform to three different rules: the regulations of the Board of Supervising Inspectors of Steam Vessels; the Philadelphia Boiler Law; the Boiler Rules of Massachusetts. They give different dimensions so designers are guided by the locality where the boiler is to be operated. An important question is the limit in size, that is, when it becomes necessary to put two or even three safety valves on a boiler in place of one. The amount of lift has a bearing on this.

It may be deduced from the above correspondence that what is needed in determining a method of rating valves is not so much research as it is standardization of practice, defined by recommendations having the weight of the Society behind them. For example, the testimony seems to show that valves having low lift and high lift are operative, and that advocates of both are to be found among people well qualified to pass opinions on the operation of valves in service. It may be that lift is a factor which, while hitherto regarded as of importance, may be neglected, and that its effect will be entirely absorbed in any arrangement which will secure a rating of valves in

accordance with their discharge capacity. This and other general questions which have been developed by its inquiry will be considered at a formal meeting of the Committee to be held at the time of the next Annual Meeting of the Society, at which time it should be possible to take the next step in the development of the Committee's work.

Respectfully submitted,

W. F. M. GOSS, <i>Chairman</i>	} <i>Research Committee</i>
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