costumes, just brought over to show their method of manufacturing butter, and through the body of the

building are the butter workers all ready for use. The churns used were the ordinary barrel, and all were alike. The cream is mixed thoroughly and dipped out, a small quantity at a time, and placed in the different churns, so as to get the quality as nearly alike as possible, the quantity being the same. Each girl then managed the cream, churn, and butter according to her fancy, and the prizes are awarded upon the quantity, appearance, and quality of the butter, after it is salted and prepared ready for market.

The attendance at all times was large, and close attention was paid to the lecturing and work. During the contests the interest was intense. The seats were packed and an immense crowd gathered on the open side of the building; and I don't wonder at it, as a more beautiful sight I never saw. Everything was scrupulously clean. The maids were very neatly though plainly dressed, and were good-looking, bright, and intelligent, and scattered among them were the Danish maids in their peculiar costume. Notwithstanding the very large attendance, so orderly was the crowd, and so intent upon hearing what Prof. Carroll had to say were they, that the only sound that interfered with the hearing of every word was the swish, swish of the 21 churns. I am promised photographs of Prof. Carroll, Miss Connell, and of the Danish maids, which I hope to receive in due time, and I will then take pleasure in showing them to *Rural* readers, with some further notes on this system of dairy instruction.—*Rural New-Yorker*.

[NATURE.]

PROFESSOR RUDOLF JULIUS EMANUEL CLAUDIUS.

By the death of Prof. Clausius, which occurred on August 24 last, science has lost another member of the great triumvirate—Rankine, Clausius, and Thomson—who, upon the foundation laid by the experimental work of Davy and Rumford, the theoretical suggestions of Mohr, Seguin, Mayer, and Colding (which, though resting on imperfect data and defective reasoning, were the results of real scientific insight), and the splendid experimental investigations of Joule, founded and built up the great structure known as the science of thermodynamics.

Clausius was born at Coslin, in Pomerania, on January 2, 1822. While yet at school in Berlin, he gave unmistakable evidence of the bent of his mind toward mathematics and physics, and on the completion of his university course he became Privatdocent in the University of Berlin and Instructor in Natural Philosophy at the School of Artillery. He very soon gave evidence of his power as an original worker, and some of his earliest papers—"On the Nature of those Constituents of the Atmosphere by which the Reflection of the Light within it is effected," and "On the Blue Color of the Sky, and the Morning and the Evening Red"—contributed to *Poggendorff's Annalen*, were selected for translation in the first volume of Taylor's "Scientific Memoirs."

In 1857 he was appointed Professor of Natural Philosophy at the Polytechnic School of the Helvetic Confederacy at Zurich. Here he continued his researches in various branches of physics, and among these we may mention, to give some idea of the extent and variety of his investigations, "The Influence of Pressure on the Freezing Point," "The Mechanical Equivalent of an Electric Discharge, and the Heating of the Conducting Wire which accompanies it," "Electrical Conduction in Electrolytes," and "The Effect of Temperature on Electric Conductivity." He also published some short papers on some purely mathematical questions, suggested, however, by physical problems, and some papers dealing with points of what is generally known as physical chemistry.

His attention was then directed toward the dynamical theory of gases, owing to the light which it appeared capable of throwing upon questions of thermodynamics. The dynamical or kinetic theory of gases, which has received such extensive developments at the hands of Clerk Maxwell, Boltzmann, and others, was originally suggested by J. Bernoulli about the middle of the last century; but it was Clausius who first placed it upon a secure scientific basis. In 1866 he published a most important paper "On the Determination of the Energy and Entropy of a Body" (translated in the *Philosophical Magazine*) in which the very valuable and suggestive conception of the entropy of a body was first set forth.

In 1869 he was appointed Professor of Natural Philosophy in the University of Bonn.

Among more recent papers of great importance we may mention the following, all of which have been translated in the *Philosophical Magazine*: "On a New Fundamental Law of Electrodynamics," "On the Behavior of Carbonic Acid in Relation to Pressure, Volume, and Temperature," "On the Theoretic Determination of Vapor Pressure and the Volumes of Vapor and Liquid," "On the Different Systems of Measures for Electric and Magnetic Quantities," "On the Employment of the Electrodynamical Potential for the Determination of the Ponderomotive and Electromotive Forces," "On the Theory of Dynamo-electrical Machines," and "On the Theory of the Transmission of Power by Dynamo-electrical Machines."

When we consider the far-reaching and fundamental character of these and many other investigations, and the very wide field which they cover, we cannot but wonder at the marvelous energy of the great physicist who has passed from among us. The Royal Society catalogue contains a list of no less than seventy-seven papers published up to 1873, and those published subsequently bring the total number up to considerably over a hundred.

In addition to these, there is his great treatise on "The Mechanical Theory of Heat," of which the first volume was published in 1864, and a smaller work, "On the Potential Function and the Potential."

It would be impossible to discuss in detail the portions of thermodynamics specially worked out by Clausius, as his work is throughout closely interwoven with that of Rankine and Thomson, but it will be of interest to quote the following from Prof. Rankine, who, in his paper "On the Economy of Heat in Expansive Machines," * says:

"Carnot was the first to assert the law that the ratio of the maximum mechanical effect to the whole heat expended in an expansive machine is a function

solely of the two temperatures at which the heat is respectively received and emitted, and is independent of the nature of the working substance. But his investigations, not being based on the principle of the dynamical convertibility of heat, involve the fallacy that power can be produced out of nothing.

"The merit of combining Carnot's law, as it is termed, with that of the convertibility of heat and power, belongs to Mr. Clausius and Prof. William Thomson; and in the shape into which they have brought it, it may be stated thus: *The maximum proportion of heat converted into expansive power by any machine is a function solely of the temperatures at which heat is received and emitted by the working substance, which function for each pair of temperatures is the same for all substances in nature.*"

None will regret the loss of Prof. Clausius more keenly than the students of the University of Bonn, where he formed a center of attraction, not only as a great investigator, but as a teacher of almost unrivaled ability. The secret of his powers as a teacher may easily be guessed from the study of his published papers and treatises. Their great characteristic is the direct insight which they give into the very heart of the physical principles under discussion. The author, while showing himself a master of mathematical methods, ever keeps the physical meaning of the symbols before the eye of the reader, and never allows his analysis to carry him away into the regions of mere mathematical ingenuity. In this he was a worthy compeer of some of our own great mathematical physicists, like Thomson and Maxwell, and the greater part of his work has the additional advantage, for the majority of students, of being effected by the aid of comparatively simple analysis.

In 1868, Prof. Clausius was elected a Foreign Member of the Royal Society, and in 1879 he was presented with the Copley medal, the highest distinction at the disposal of the Society. He was decorated with various civil Prussian and Bavarian orders; and after the Franco-German war, during which he had volunteered to serve as caretaker of the wounded, he received the German decoration of the iron cross and the French decoration of the legion of honor.

G. W. DE TUNZELMANN.

A New Catalogue of Valuable Papers

Contained in SCIENTIFIC AMERICAN SUPPLEMENT during the past ten years, sent free of charge to any address. MUNN & CO., 361 Broadway, New York.

THE SCIENTIFIC AMERICAN Architects and Builders Edition.

\$2.50 a Year. Single Copies, 25 cts.

This is a Special Edition of the SCIENTIFIC AMERICAN, issued monthly—on the first day of the month. Each number contains about forty large quarto pages, equal to about two hundred ordinary book pages, forming, practically, a large and splendid Magazine of Architecture, richly adorned with elegant plates in colors and with fine engravings, illustrating the most interesting examples of modern Architectural Construction and allied subjects.

A special feature is the presentation in each number of a variety of the latest and best plans for private residences, city and country, including those of very moderate cost as well as the more expensive. Drawings in perspective and in color are given, together with full Plans, Specifications, Costs, Bills of Estimate, and Sheets of Details.

No other building paper contains so many plans, details, and specifications regularly presented as the SCIENTIFIC AMERICAN. Hundreds of dwellings have already been erected on the various plans we have issued during the past year, and many others are in process of construction.

Architects, Builders, and Owners will find this work valuable in furnishing fresh and useful suggestions. All who contemplate building or improving homes, or erecting structures of any kind, have before them in this work an almost endless series of the latest and best examples from which to make selections, thus saving time and money.

Many other subjects, including Sewerage, Piping, Lighting, Warming, Ventilating, Decorating, Laying out of Grounds, etc., are illustrated. An extensive Compendium of Manufacturers' Announcements is also given, in which the most reliable and approved Building Materials, Goods, Machines, Tools, and Appliances are described and illustrated, with addresses of the makers, etc.

The fullness, richness, cheapness, and convenience of this work have won for it the Largest Circulation of any Architectural publication in the world.

MUNN & CO., Publishers,
361 Broadway, New York.

A Catalogue of valuable books on Architecture, Building, Carpentry, Masonry, Heating, Warming, Lighting, Ventilation, and all branches of industry pertaining to the art of Building, is supplied free of charge, sent to any address.

Building Plans and Specifications.

In connection with the publication of the BUILDING EDITION of the SCIENTIFIC AMERICAN, Messrs. Munn & Co. furnish plans and specifications for buildings of every kind, including Churches, Schools, Stores, Dwellings, Carriage Houses, Barns, etc.

In this work they are assisted by able and experienced architects. Full plans, details, and specifications for the various buildings illustrated in this paper can be supplied.

Those who contemplate building, or who wish to alter, improve, extend, or add to existing buildings, whether wings, porches, bay windows, or attic rooms, are invited to communicate with the undersigned. Our work extends to all parts of the country. Estimates, plans, and drawings promptly prepared. Terms moderate. Address

MUNN & CO., 361 BROADWAY, NEW YORK.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, \$5 a year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, \$2.50 stitched in paper, or \$3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, \$7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,
361 Broadway, New York, N. Y.

TABLE OF CONTENTS.

	PAGE
I. BIOGRAPHY.—Professor Rudolf Julius Emanuel Clausius.—Biographical note of the great investigator in thermodynamics, with abstract of his life, discoveries, and papers published and read by him.	10934
II. BIOLOGY.—Yeast: Its Morphology and Culture.—By A. GORDON SALAMON.—Conclusion of the third lecture of this interesting course, including a review of the protoplasmic state of matter, with analysis of the lower form of vegetable tissue.	10932
III. CIVIL ENGINEERING.—Automatic Registering Dynamometer.—A true power meter registering the power transmitted by a line of shafting.—6 illustrations.	10924
The A. J. Hartford Steel Railway Tie.—A new steel tie, offering perhaps the desired substitute for the wooden tie now in such extensive use.—5 illustrations.	10922
The Canadian Pacific Railway.—Note of the picturesque scenery upon the route, snow sheds, canons, and other graphic features.—4 illustrations.	10920
The Canadian Pacific Railway.—By THOMAS C. KEEFER.—A review of the importance of the new Canadian enterprise, its finances, prospects, and route.—Geological and other features of the ground passed over, with map.—1 illustration.	10920
The First Chinese Railway—China, Tientsin, and Kaiping Railway.—A graphic account of the first railroad built by the Chinese government, officially opened in September of last year.	10927
IV. EDUCATION.—Dairy Schools and "Working Dairies."—By J. S. WOODWARD.—The English and Irish schools for teaching butter making.—Scope of the instruction, including programme of one day's work.—A butter making contest.—1 illustration.	10933
V. NAVAL ENGINEERING.—New System of Towing.—A new system of towing vessels devised by Admiral Albini, of France, involving the application of a tube in place of a rope for towing vessels at sea.—2 illustrations.	10922
Progress of Our New Navy.—A most timely article on the progress of the United States navy, with list of vessels, their tonnage, guns, condition, etc.	10923
VI. PHYSICS.—Electricity, Light, and Heat.—By Prof. C. F. BRACKETT.—Continuation of this important paper, treating of the relations between the three vibratory forces and the significance of the recent experiments of Prof. Herz.	10931
VII. TECHNOLOGY.—An Improved Blow Pipe.—An improved blow pipe for producing a strong flame from benzoline with perfect safety from danger of conflagration.—1 illustration.	10930
Improved Gas Engine and Pump.—A full description, with abstract of results attained, cylinder curves, horse power, etc., of the Atkinson gas engine.—12 illustrations.	10927
Improved Ice Making Machine.—An ice machine of the vacuum type fully described and illustrated, one adapted for making ice on board ship or in confined places.—5 illustrations.	10930
Machine for Branding Wood.—A machine for marking trade designations upon wood for boxes or other purposes with a hot iron.—1 illustration.	10929
The Compressed Air Company of Paris.—The company organized for the distribution of power by compressed air, with description of its plant, system of distribution, motors, etc.—6 illustrations.	10924

Useful Engineering Books

Manufacturers, Agriculturists, Chemists, Engineers, Mechanics, Builders, men of leisure, and professional men, of all classes, need good books in the line of their respective callings. Our post office department permits the transmission of books through the mails at very small cost. A comprehensive catalogue of useful books by different authors, on more than fifty different subjects, has recently been published, for free circulation, at the office of this paper. Subjects classified with names of author. Persons desiring a copy have only to ask for it, and it will be mailed to them. Address,

MUNN & CO., 361 Broadway, New York.

PATENTS.

In connection with the Scientific American, Messrs. MUNN & Co. are solicitors of American and Foreign Patents, have had 42 years' experience, and now have the largest establishment in the world. Patents are obtained on the best terms.

A special notice is made in the Scientific American of all inventions patented through this Agency, with the name and residence of the Patentee. By the immense circulation thus given, public attention is directed to the merits of the new patent, and sales or introduction often easily effected.

Any person who has made a new discovery or invention can ascertain, free of charge, whether a patent can probably be obtained, by writing to MUNN & Co.

We also send free our Hand Book about the Patent Laws, Patents, Caveats, Trade Marks, their costs and how procured. Address

MUNN & CO.,
361 Broadway, New York.

Branch Office, 622 and 624 F St., Washington, D. C.

* Rankine's "Miscellaneous Scientific Papers," p. 300.