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NEW YORK, SATURDAY, JULY 5, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

PROSPECTIVE COMPLETION OF THE PANAMA INTEROCEANIC CANAL.

The passing of the Senate Panama canal bill without amendment on June 26 by the House of Representatives by a vote of two hundred and fifty-two in favor to eight against may be regarded as a memorable act of legislation calculated to promote the growing commercial supremacy of the United States, for it insures the construction of an inter-oceanic canal, which when finished will be used by the entire commercial world. Quickly following the passage of the bill the President completed the law by affixing his signature on June 28, thus bringing to a successful close the interocean canal discussions and controversies so long pending.

The first step to be taken by the President under the act is the negotiation of a treaty with the Colombian government, which it is thought will be completed for ratification by the Senate next December.

At the same time, it is probable all the stipulated concessions and rights of the New Panama Company will be secured.

Then the President will appoint the Isthmian Commission, subject to ratification by the Senate. When so approved, the Commission will make preparations to begin the work, let us hope within the year. It is calculated eight or nine years will be required to complete the canal.

When the work actually begins, it is evident that there will be excellent opportunities for the display of American skill and American enterprise; and no one can doubt that American devices and machinery, guided and managed by American engineers, will be able to surmount many difficulties that may arise. The work is certain to arouse national interest, especially as the plan of a popular subscription to the bonds is provided.

It shall be our aim to keep our readers informed about this great work as it progresses. Full data concerning the present state of the canal and Isthmian commission's report will be found in the Scientific American Supplement, Nos. 1359, 1361, and the Scientific American of January 18, 1902.

A PRUSSIAN OPINION OF AMERICAN RAILWAYS.

Some two years ago the Prussian government sent to the United States a committee of official experts to study the methods of railway construction and management in this country, for the purpose of determining whether or not it would be advisable to introduce American ideas in Germany. The commission spent several months in the United States, and made elaborate studies of everything pertaining to American railway building. It was hoped that these studies would eventually be published in an official report; but the government has decided not to give to the public the results of the commission's work. Baron von Thielen, Chief of the Prussian Ministry of Railways, has, however, granted interviews, in which some of the conclusions drawn by the commission have been divulged.

It is admitted that much was learned in the United States. Especially interesting and valuable was the American plan of locomotive construction in standard types with interchangeable parts. German railways will probably soon adopt the American idea, at least to a certain extent.

But so far as freight and passenger cars are concerned, it was considered doubtful whether American practice was suitable for Germany. In the United States it is found extremely economical to haul enormous masses of freight over long distances in forty, fifty or sixty-ton freight cars. In Germany, where the amount of freight handled is much smaller, and the distance to which it is transported far shorter, the need for individualizing shipments is so general that the introduction of large American freight cars will probably be attended with serious difficulty. The old ten-ton German freight car, in the opinion of Baron von Thielen, might well give way to a car of thirty tons capacity. But enlargement beyond that limit would necessitate changes in track, switches, platforms and especially in the loading and unloading arrangements of mines, furnaces and large manufacturing plants. It is, therefore, to be inferred that the Prussian freight car of the future will have a maximum capacity of thirty tons and will be mounted on bogie trucks of the American type.

In the matter of passenger cars, the Prussian State Railways have adopted a definite model for long-distance service. A vestibule car is used, varying in length from 58 to 60 feet and running on two four-wheeled trucks. Each car is divided into compartments, with a corridor aisle running along one side. The introduction of Pullman cars has not been a success. Three Pullmans of the standard American pattern were given a trial in Germany. That they were admirably built, that they ran with remarkable smoothness and freedom from jar and noise, was admitted. Nevertheless, the German public prefers a car divided into small compartments, each accommodating six or eight passengers. American sleeping cars are no more popular than the Pullmans. The German sleeper is divided into small compartments, each containing an upper and a lower berth, and each having a separate washbowl and water supply. American drawing-room and sleeping-cars are considered much too heavy, much too richly upholstered, and, therefore, much too costly. But the cheapness of special fare on these cars is frankly admitted.

This, in brief, is the opinion of the commission. It was admitted that the American system was most admirably adapted to the United States, where long distances are to be traversed, where railways are owned by corporations who must keep a sharp eye on their rivals, where social relations are based on equality and restrictions of caste do not exist. The Prussian railway system, on the other hand, is the property of the state. After slow development from small beginnings, and after much planning and scheming, it has finally been brought to pay not only the entire interest on the Prussian debt, but to earn a yearly surplus. But it cannot be doubted that the rates for freight and first-class passenger fares are high, so high, indeed, that the farmers and inland industries are in a measure crippled.

THE NEED OF A LOCOMOTIVE SMOKE CONSUMER.

The begrimed buildings of New York city, and the vast black veil of smoke which envelops the metropolis, speak eloquently of the hardships to which the inhabitants of the Eastern States are subjected by the use of soft coal, rendered necessary by the strike of anthracite miners. So limited is the supply of hard coal, and so high its price, that the Manhattan Elevated Railroad Company, as well as the owners of large office buildings, have persisted in burning soft coal, despite the fact that the Sanitary Code of New York expressly prohibits the discharge into the atmosphere of smoke and injurious vapors. The firm stand taken by the Health Board of the city has resulted in the adoption of consumers by owners of office buildings. The evil has thereby been partly mitigated; but the Elevated Railroad Company day after day continued to discharge into the air its volumes of smoke, which, as the newspapers expressed it, "hung like a pall over the city," until the Board of Health succeeded in prohibiting the use of soft coal.

If the office buildings have found the use of smoke consumers practicable, the question naturally arises, Why is it the locomotives of the railway companies cannot be equipped with similar apparatus to prevent the contamination of the city's atmosphere? The Elevated Railway officials stated that they knew of no practical smoke consumer which could be applied to their locomotives.

The problem of burning bituminous coal in locomotives without the production of black smoke, has confronted railway engineers for some time. It has been clearly enough proved that the smoke can be almost entirely done away with by using the proper precautions in firing. Coal thrown into the firebox a half shovelful at a time, is rapidly consumed by the intense heat of the fire, and with it the smoke. But if the fuel be tossed into the firebox in large quantities, which is the practice of the indolent fireman, a thick layer is formed over the fire, which is not consumed for some minutes and which loses a goodly amount of fuel in the form of a thick smoke. How large a percentage of fuel is thus lost may be inferred from the analysis of a sample of snow, gathered ten days after it had fallen in the outskirts of Manchester, England. After melting the snow a residue was obtained which was equivalent to over 10 pounds to the acre, and which consisted of 48.6 per cent carbon, 8.9 per cent grease and 44.5 per cent ash. Another sample, taken from the heart of the city, contained nearly three times this amount of residue, or in other words, about a ton of soot per square mile a day. Waste of any kind nowadays is unpardonable; and with the world's supply of coal visibly nearing exhaustion, wanton waste of fuel is more than unpardonable.

Mechanical stokers combined with special types of firebox have been found completely to solve the smoke problem for stationary plants. Some similar arrangement has long been needed for locomotives. What is wanted is a mechanical stoker, simple in construction and practical in operation, which can be applied to a locomotive without necessitating any great alterations. Such a stoker was invented a short time ago by a former engineer of the Chesapeake & Ohio Railway. In this appliance the coal is scattered in a thin layer over the fire, thereby avoiding the constant opening of the firebox, and the consequent admission of cold air. Not only is it claimed that fuel is saved, but that nine-tenths of the thick, black smoke usually produced by hand-firing with soft coal is done away with. The provision of a simple smoke-consumer which will permit the burning of soft coal within the limits of large cities without annoyance to the inhabitants is a problem that certainly deserves the attention of American inventors. Up to the present, too little time and thought have apparently been lavished upon the subject.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—GREAT BARRINGTON MEETING.

BY WILLIAM H. HALE, PH.D.

A notable gathering of electrical engineers was the meeting of the American Institute at the Berkshire Inn, Great Barrington, Mass., June 18 to 21, both in its social and its scientific features. Owing to the absence in Europe of President Scott, Mr. Charles P. Steinmetz, the retiring president, presided.

The first day was occupied with papers and discussions upon alternating current work, and included an account of the new generating plants of the Niagara Falls Power Company, by Mr. Harold W. Buck; other papers were by Messrs. Baum, Le Blanc and Steinmetz.

The second day of the session was devoted to papers and discussion upon electric railway work. Mr. A. H. Armstrong read a study of the heating of railway motors, in which he discussed the problem of keeping the temperature of the motive power within reasonable limits; also the operation of single cars at maximum speeds of 60 to 70 miles per hour. He finds it preferable to use the largest gear ratio and highest rate of acceleration possible for the accomplishment of the service contemplated, provided the maximum speeds are low, but that practically any rate of acceleration can be used where speeds approach a maximum of 60 miles per hour. The expense of running single cars is much greater per ton than running the trains, being more than double that required for five-car trains.

Mr. C. O. Mailloux presented notes on the plotting of speed-time curves, giving a practical and ingenious method readily applicable and obviating the necessity of complicated mathematical calculations in many cases; also an experiment with single-phase alternators on polyphase circuits, incidentally illustrating the elasticity of the polyphase system, which was recently tried successfully at Phœnix, Ariz., and which is a practical demonstration of the possibility of using single-phase alternators as the source of energy for supplying polyphase currents, both two-phase and three-phase, and also for supplying direct current to a transmission and distribution system.

Messrs. Bion J. Arnold and W. B. Potter presented comparative acceleration tests with steam locomotive and electric motor cars, showing that the latter can accelerate much more rapidly than the former, and can maintain a higher average speed with lesser maximum speeds than the former, thus consuming less energy for the run.

The efficiency of an electrical system as an average under variable load may be assumed as follows:

Engine	90 per cent	efficiency.
Alternator	92 per cent	"
High potential transmission	98 per cent	"
Transformers	97 per cent	"
Converters	92 per cent	"
Third rail	95 per cent	"

Motors, including control, 75 per cent efficiency, 51.33 per cent.

These tests were made on the main tracks of the N. Y. C. & H. R. R. R., west of Schenectady, and were for the purpose of determining the availability of electric traction in the new Park Avenue railroad tunnel in New York.

Mr. Arnold followed with an elaborate report of the method of ascertaining by means of a dynamometer car the power required to operate the trains of the N. Y. C. & H. R. R. R. between Mott Haven Junction and Grand Central Station, and the relative cost by steam and electricity.

This division consists of 5.3 miles of four-track road, of which 0.68 mile from the station is in an open cut, 2.04 through a tunnel under the street and 2.58 miles on an elevated stone and steel structure to Mott Haven Junction.

The most practical method of ascertaining the power required to propel the trains was to measure by means of a dynamometer car the draw-bar pull of various trains. The braking effort per ton is not so high on certain types of locomotives as it is on coaches, due to the fact that not all wheels on the locomotive are always braked, and those that are braked cannot be set to the skidding point with a fully loaded tender, for if they were they would then skid with a slightly loaded tender.

Mr. Arnold recommends instead of the ten or twelve different types of locomotives now used electric motors weighing about 65 tons each, which for heavy work can be coupled. He stated that if given the opportunity he would make the necessary changes and install the new system within six months. The third rail is recommended for the tunnel, and the overhead system for the yards.

Of twelve different plans considered, the first, theoretically the most economical, provides for a direct-current power station at center of line and contiguous to tracks, 600-volt working conductors, no batteries, but this is impracticable because it would locate the power house in the residential portion of Park Avenue.

The twelfth plan therefore was the one recommended, namely, combined alternate-current and direct-current power station at Harlem River near outer end of line, one sub-station near other end. Batteries in power station and sub-station. Alternate-current transmission, 11,000 volts, direct-current conductors 600 volts.

While Mr. Arnold believes the alternating-current railway motor to be the most efficient, all things considered, for long-distance railway work, it has not yet demonstrated its ability to start under load as efficiently nor to accelerate a train as rapidly as the direct-current motor. The latter have also become standardized, and are the only type readily procurable from manufacturers in the United States; hence they are recommended for this terminal traction work.

Although the question of economy is relatively unimportant, safety and comfort being first to be considered, yet there is a slight economy also in the substitution of electricity for steam, as shown by the following table:

	Steam.	Electricity.
Operating expenses per mile exclusive of fixed charges, but including water, labor, cost of cleaning and repairing tunnel, and all other expenses of locomotive operation	23.05	15.80
Fixed charges per locomotive mile, assuming that it now requires 40 locomotives to perform the present service and that 33 electric locomotives could perform the same service	1.13	7.83
	24.18	23.63

Perhaps the most important incident of the entire meeting was the announcement by Mr. Arnold, in closing the discussion of this paper, that he had invented a new system of electric traction whereby he utilizes waste forces and regulates and stores up force without depending on regulation from the power house. This is effected by applying surplus force to the compression of air, which as necessity requires, is released and adds the force needed to meet extra demands. Thus the motor can climb a grade as rapidly as it can descend; it can climb steep grades; by using its reserve it can traverse gaps in the line over private right of way, or onto spurs, sidings, etc.; so that ultimately power need only be transmitted along the main line, and also a great saving can be effected in buildings for conversion, etc. President Steinmetz commended the invention as one of great importance.

The third day was occupied with papers and discussions on various topics, lightning arresters, photometers, a curve-tracing instrument, loss of energy in transmitting power, electrostatic wattmeter, predetermination of alternator characteristics, by Messrs. Thomas, Matthews, Owens, Skinner, Walker and Herdt respectively.

The feature of the day, however, was the report of the committee on standardization by Dr. A. E. Kennelly and the ensuing discussion.

Much satisfaction was expressed that the government has now established a bureau of standards which is conducted in harmony with electricians. The report was adopted except that two sections were referred back to the committee with power of revision and of final settlement. One important matter which the Institute thus leads off in establishing without awaiting governmental or other sanction, but confident that its action will meet general approval and command universal acquiescence, is the fixing of a standard for candle power. After full discussion the recommendation of the committee was approved; and the standard, as far as the Institute can fix it, makes the Hefner = 0.88 British candle, as the ratio of horizontal intensities. The Hefner-Alteneck amyl-acetate lamp is—says the report—in spite of its unsuitable color, the standard luminous source generally used in accurate photometric measurements.

Prof. Owens presented the invitation of McGill University to hold the next meeting of the Institute at Montreal. A similar invitation has already been sent to the British Institution of Electricians. The Institute adopted a resolution inviting the British Institution to hold a joint meeting; but owing to the belief that probably 1904 would be preferred on account of the St. Louis Exposition, date and place were left undetermined.

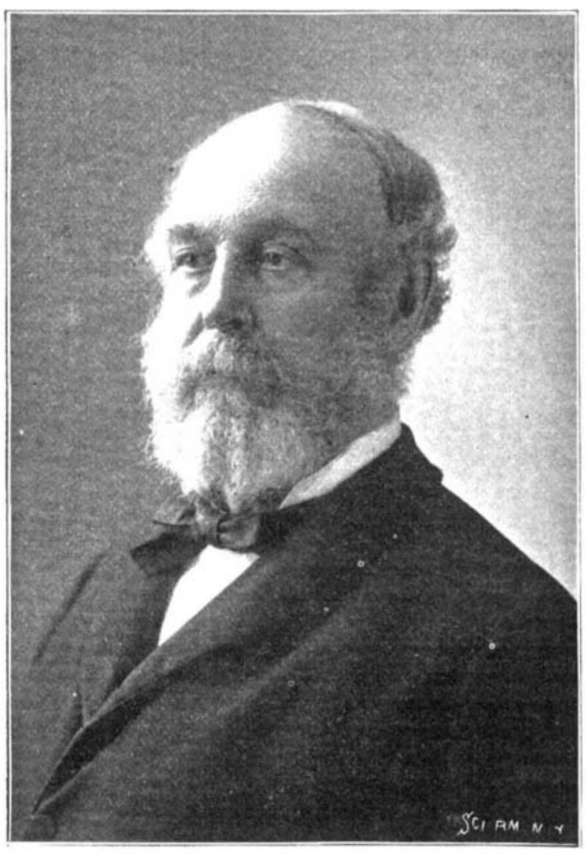
The exercises of the last day of the session consisted of papers and discussion on the education of an electrical engineer, by Messrs. Steinmetz, Sheldon, Owens, Esty, Buck and Raymond.

ASAPH HALL.

BY MARCUS BENJAMIN, PH.D.

The American Association for the Advancement of Science has two characteristic features. It meets in a new place and inaugurates a new president each year. In 1901 it met under the shadow of the Rocky Mountains in Denver, and this year it meets in the great industrial center of Pittsburg. The eminent naturalist, Prof. Charles S. Minot, who presided so gracefully in the West, yields the chair to an equally distinguished representative of the physical sciences.

Asaph Hall was born in Goshen, Conn., on October 15, 1829, and received a common school education in his native town. For a time he worked on a farm, but when he was sixteen years old he took up carpentry and followed that trade for many years. Meanwhile a thirst for knowledge that would not down came to him, and in his twenty-fifth year he began the study of geometry and algebra in the Norfolk Academy. Later he went to Wisconsin, and still later to Ohio, in both of which States he taught school, from the earnings of which he was able for a single term to study at the University of Michigan.



ASAPH HALL.

In 1857 he entered the observatory at Harvard as a student, but his abilities were so manifest that he was almost immediately assigned to the working staff with the rank of assistant, remaining in that capacity until August, 1862, when he was appointed an aid in the United States Naval Observatory in Washington. A year later he was made Professor of Mathematics in the United States Navy, and remained as such until 1891, when he was retired with the relative rank of captain. It is with the United States Naval Observatory that his name will be associated always for the brilliant discoveries that were made by him and which have gained for him such eminence among the astronomers of the world.

In addition to the usual routine work required at the Naval Observatory, he was from time to time assigned to important astronomical expeditions. These have included the parties sent to observe the solar eclipse from Bering Sea, and from Sicily, Italy, in 1870. He had charge of the American party sent to Vladivostok, Siberia, to observe the transit of Venus in 1874, and was chief astronomer of the expedition stationed at San Antonio, Texas, at the later transit in 1882.

His most famous contribution to astronomy was the discovery of the moons of Mars. Exact calculations were made of their orbits, and Prof. Hall gave to them the names of Deimos and Phobos (Wrath and Fear), from the passage in Homer's "Iliad" where these two divinities are mentioned as the attendants of the god of war.

His subsequent work has included important observations of double stars, an account of which he published in 1880. He also devoted much attention to Oberon and Titania, the outer satellites of Uranus, publishing in 1886 the results of observations made by him during 1875-76 and 1881-84 with the large telescope of the Naval Observatory. In the same year he gave to the world the results of similar observations on the satellite of Neptune and on that of Saturn.

On his retirement from the service of his government, he settled in Cambridge, Mass., and renewed the experiences of his early manhood with valuable work in the Harvard Observatory. Recently he returned to the home of his boyhood in South Norwalk, Conn.

In 1878 the Lalande prize of the French Academy of Sciences was awarded him for his discovery of the moons of Mars, and in 1879 he received the gold medal of the Royal Astronomical Society, "for his discovery and observations of the satellites of Mars, and for his determination of their orbits," as "the highest mark of esteem in the gift" of that Society, while in 1895 he received the Arago medal of the French Academy of Sciences.

In further recognition of his contributions to his chosen science, Hamilton conferred upon him the degree of Ph.D. in 1878, and that of LL.D. was given him by Yale in 1879, and by Harvard in 1886.

Prof. Hall has been elected to numerous scientific societies both in this country and abroad, including the French Academy. In 1875 he was chosen to the National Academy of Sciences, of which in 1883 he became home secretary, and in 1897, on the death of Gen. Francis A. Walker, he was chosen vice-president.

His connection with the American Association has been a long and honorable one. He joined that organization in 1876 and a year later was made a fellow. In 1880 he presided over Section A, delivering a retiring address at the Boston meeting on "The Advances in Astronomy," in which he said that "the great value of astronomy is that it is really a science, and that it has broken the path and led the way through which all branches of science must pass if they ever become scientific."

TIMBER RAILWAY BRIDGES IN AUSTRALIA.

In Australia, when the first railroads were constructed, the bridges were almost entirely built of timber, and even now this type of bridge is often erected in lieu of steel structure, as the native woods —seventeen varieties are available—are specially adapted to the work, owing to their great strength. The life of such bridges varies from thirty-five to fifty-five years, according to their location and other circumstances. In Queensland a large timber bridge has recently been completed. It is 320 feet long and 18 feet 6 inches wide. It spans a creek 10 feet deep at high-water mark, and which also has 20 feet of black mud below the bed. In flood times the water rises 25 feet above the level of ordinary high-water mark. The supporting piles are of iron bark timber well creosoted. The cost of driving the piles complete, including materials, labor, plant, etc., was $1.80 per lineal foot. The decking and its members are of spotted gum, and the cost was $19.80 per square, including all material and labor. The total weight of all the timber in the bridge as fixed is about 200 tons, while the weight of the iron work fixed is 4½ tons. The total cost of the structure, including a small portion of the approach roadway, was $9,500. The principal and most durable kinds of timber suitable for bridges are ironbark, spotted gum, blue gum, bloodwood, blackbutt, box, mahogany, karri and swamp mahogany. Ironbark, mahogany, blue gum, bloodwood, swamp mahogany, turpentine or peppermint, tea, she-pine and cypress pine are very durable when constantly immersed in water or wet ground, and are, therefore, well adapted for piles, etc., for the foundations.

The various methods of seasoning at present in vogue consist either in evaporating the sap by air-drying, or in dissolving it in water and afterward sun-drying the timber. Artificial drying is rarely resorted to with timber for engineering purposes. The greatest trouble against which the engineers have to contend are the ravages of the teredo, white ant, and other similar insects, and various means of protecting the wood against these pests are resorted to, the most general being the sheathing of the wood in copper. But even copper sheathing is not permanently effectual in resisting the attacks of the teredo. Creosoting properly carried out is the most successful of any process yet known. The various means of preserving the timber consist of painting, charring, creosoting and impregnation with metallic salts. The latter method, however, has not in all cases given satisfactory results.