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NEW YORK, SATURDAY, MAY 3, 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.

THE PANAMA CANAL TREATY.

A most important step has been taken toward the solution of the Isthmian Canal problem by the signing of a treaty by Secretary Hay and the Colombian Minister for a perpetual lease of the strip of land through which the Panama Canal is located. By this treaty the sudden deadlock in the negotiations, which was produced by the declaration of the Colombian government that it would have to be consulted before the selling of the Panama Canal Company's property was consummated, is removed, and the company is granted, unreservedly, the power to dispose of its entire right, title and interest to the United States, while all the questions relating to land franchises, revenues, rentals, etc., are satisfactorily settled. A strip of land six miles in width is to be perpetually leased to the United States, the lease to run by hundred-year periods and to be renewable at the option of the United States. By this treaty, the terminal cities Panama and Colon, the waters of the terminal harbors, and the islands adjacent, are brought under the control of the United States government. While no definite price is fixed by Colombia for these concessions, on the ratification of the treaty the United States is to pay to Colombia the sum of seven million dollars, in exchange for which Colombia foregoes all revenues from rental and from every other source connected with the canal for a period of fourteen years from the date of the final ratification. Meanwhile the terms of the rental are to be agreed upon. This may be either a lump sum paid in cash or an annual stipend to be paid for the remaining eighty-six years of the lease. Should the two governments disagree as to the terms of the rental, the question is to be decided by a tribunal of five members, two named by the United States, two by Colombia, and the fifth to be the presiding member of the Hague International Arbitration Court, or the president of one of the republics not allied to either party. This important document is not, as has generally been supposed, a mere protocol, but it is a full treaty, and as such will probably be sent to the Senate by the President immediately upon the passage of an act authorizing the construction of the canal.

GREAT STEAMSHIP COMBINE.

The many rumors that there was to be a combination on a colossal scale of the interests of some of the largest transatlantic steamship companies, have proved correct. Five of these companies, the White Star, Dominion, Leyland, Atlantic Transport, American and Red Star lines, with an aggregate tonnage that is estimated at nearly 850,000 tons, have been merged under the direction of J. Pierpont Morgan who, since the announcement of this important co-operation, has talked very freely concerning the aims and purposes of the movement. The capitalization of the consolidated companies is estimated to be in the neighborhood of two hundred million dollars, which fairly well represents the value of the property absorbed. According to the General Manager of the American Line, while the control of the company will be held in this country, it will be a strictly international organization, fostering the various companies included in the consolidation, preserving their autonomy, and giving every respect to their national and local surroundings. The avowed object of the combination is to afford better transatlantic service at a decreased cost. Hitherto the trade has been conducted extravagantly; and as a result of the conflicting interests, the sailings of the various steamers have not been arranged on the basis which would be most convenient and profitable, either to the companies or to the public. Other advantages expected are more uniform rates, a better distribution of traffic over the American and Canadian seaports, and additional lines on the Pacific and to South American ports, as the growth of traffic may be found to justify them. With lines already established between Great Britain and Australia and New Zealand, and with intimate connections with the Far East, the combine will be in the position to distribute American manufactured products throughout the world on through bills of lading, and to avoid the expense of transshipments which are incurred under the present arrangement.

It is claimed that the combination has no relation whatever to the question of the Subsidy Bill. Should the bill as considered by the Senate become law, of all the 850,000 tons owned by the combine, only a few vessels of the American Line could fly the American flag, and this for the reason that registry would be granted only to American-built vessels. Moreover, the company frankly admits that, failing the passage of the bill, they will build their ships in the cheapest market; which means that, as it costs twenty per cent more to build here than in Great Britain, the orders for new ships will go to British yards. On the other hand, should the Subsidy Bill be passed, there is no question that all the new ships for the combination, or a greater part of them at least, will be constructed in American yards and a powerful impulse will thus be given to the shipyards of this country.

STEERING WITH TWIN-SCREW ENGINES.

The advantages of the twin-screw system of propulsion of steamships have been proved once more in the case of a disabled Atlantic steamship. In this case it was the "Deutschland," the fastest of the transatlantic liners, that got into trouble, her rudder having been carried away at a point 400 miles west of Bishop's Rock. To a single-screw ship this disaster would have meant complete disablement; for although smaller vessels have been steered by jury rudders consisting of floating spars towed astern of the vessel, no such makeshift device could be rigged up that would control a 23,000-ton liner. As it was, however, by means of signals sent down from the bridge to the engine room it was possible to keep the great vessel on a true course, the port or starboard engine being given more or less steam to counteract the veering of the vessel as she sheered to port or starboard. It is conceivable that in ordinary weather a twin-screw ship would experience but little delay from an accident which, happening to a big liner of a dozen or fifteen years ago, would have rendered her completely helpless.

COMBINING THE AIRSHIP AND THE AEROPLANE.

Commenting in a recent issue upon the present prospects of successful aerial navigation, we pointed out that the great difficulty in constructing a practicable balloon airship was the great surface presented by the balloon to the wind, and the impossibility of producing a light motor of sufficient power to hold the airship against any but the most moderate winds. We also showed that the inherent difficulty of the aeroplane was its lack of what might be called static stability, and the difficulty of controlling the machine in making landings. The strong point in the one type is the weak point in the other. The airship can float and possesses stability, but its bulk and weight are fatal to speed and control. The aeroplane has no capacity for flotation and soaring except when in motion, and in its present stage of development it is a contrivance full of the greatest risk to life and limb. On the other hand, it is by far the lighter type of the two, and if the problem of control can only be solved, the questions of securing high speed and a wide radius of action, are merely a question of the production of a motor of great power for a given weight.

Just at present the most successful work in aerial navigation seems likely to be accomplished by a combination of the two types. Elsewhere in our columns we illustrate a machine built upon this principle, which is now being constructed for the British War Office. It is a true airship, of the type constructed by Count von Zeppelin and again by Santos-Dumont, the lifting capacity of the gas balloon being five tons. At the same time it is a true aeroplane, with a lifting capacity due to its planes of nearly a thousand pounds. The flotation of the device will be secured by the balloon, and the raising and lowering will be accomplished by the manipulation of the aeroplanes. We confess that apart from the fact that so conservative a body as the British War Office have entered upon the construction of a full-sized machine, there are features in the design of Dr. Barton which give reason to expect good results. Although it is only 180 feet long, as against a length of over 400 feet for the Count von Zeppelin balloon, its motors have a combined horse power of 135, which is much the largest installation yet placed on an airship. Zeppelin's great machine had only 32 horse power, while the new machine, No. 7, of Santos-Dumont with which he will experiment in this country, has a total of only 80 horse power. The combination of the balloon and the aeroplane should give an extreme nicety of lifting and lowering control, while the provision of water tanks at either end of the platform and an automatically-controlled circulation is a mechanical feature which will commend itself to every engineer. In view of the great power, the expected speed of 20 miles an hour is decidedly conservative.

SANITARY CONDITION OF STREET CARS.

In view of the not inconsiderable portion of their time that the busy workers of a great city spend every day in the street cars, it must be admitted that the great importance which is attached by medical men to the sanitary condition of these cars is completely justified. For the average citizen there is not merely the long morning and evening ride to his place of business, but for many of us there is to be included much other time spent on the cars during the working hours of the day, and to this must frequently be added a ride of greater or less length to and from the theater or other place of entertainment at night.

Under normal conditions, with a car only comfortably filled, the air, especially in the winter-time when ventilators and doors are kept tightly closed, is none of the best; and in the rush hours by day, and the theater hours at night, when the cars are jammed to the very doors and even to the steps of the platforms, the air is polluted to a point at which it becomes positively injurious to health. In the current issue of the SUPPLEMENT will be found an article by Dr. George A. Soper, of this city, dealing at considerable length with the sanitary condition of street cars in which the oft-repeated assertions as to the insanitary condition of street-car travel are substantiated by carefully-ascertained statistics. The physiological effects of poor ventilation are given as reduction of heart-action, increase in the rate of respiration, tendency toward headache, loss of appetite, reduction of vitality, nervous exhaustion and, in severe cases of delicate organization, the result of breathing vitiated air will be shown by nausea. Furthermore, the ability to resist disease is greatly lessened where the ventilation is poor. The tissues of the air passages of the nose and throat, which normally have the power of rejecting or destroying dangerous bacteria, become impaired, and the entrance and development of the organisms which are the cause of bronchial and pulmonary disease is favored.

The inefficient ventilation in street cars, particularly during the rush hours of the winter season, is too painfully evident, especially to those who are at all sensitive to vitiated atmosphere, to need much practical demonstration; but accurate analyses which have been made of samples of air taken from street cars, elevated cars and from trains running in the various tunnel systems both in this country and abroad, prove that the distress experienced by the "fresh air fiend" is only too well founded on physiological facts. Fresh air contains about three parts of carbonic acid, and air which has passed through the lungs, 441 parts of carbonic acid per 10,000 volumes, and the air of inclosed spaces becomes "close" when carbonic acid exists to the extent of about five parts per 10,000 volumes; hence, Dr. Soper deduces that about 50 cubic feet of fresh air should be admitted to each car every minute for each person it contains. It is perfectly certain that no such ventilation takes place, at least in the winter-time, and analyses of samples of air taken from cars in New York showed that they contained as much as 26.2 parts of carbonic acid gas as against the three parts found in fresh air. On account of the less frequent opening of the doors, it has been found that on the elevated roads the percentage is higher, samples having been found to contain as high as 31.2 parts of carbonic acid. A table showing the amount of this poison in the air in various tunnels and street cars proves that the worst offender is the Mont Cenis tunnel, with 107 parts per 10,000 volumes. The Mersey tunnel, Liverpool, showed from 7.4 to 26.4 parts, and the South London Electric Railway tunnel from 8.4 to 10.8 parts. These results on electric roads are to be compared with those shown in the steam-operated Metropolitan Railway tunnel, London, where there was a maximum of 89.4 parts. In the Boston subway, the samples contained from 6.63 to 9.45 parts, while an electric car in the Boston subway showed a maximum of 24.97 parts.

This subject should have particular interest just now in view of the subway systems which are being constructed in this and other cities. We believe our tunnel Commissioners are relying upon the piston-like action of the trains themselves in passing through the tunnel to serve the purpose of ventilation, the theory being that the movement of the train carries a body of air in front of it and sucks in at the stations and various openings fresh air from above. We fear that the expectations based upon this theory are liable to disappointment in the case of the new subway, for the reason that the conditions are not parallel to those obtaining in the tube tunnels, say of London, where there is only one track laid in each tunnel and the train is built so as to conform to the section of the tunnel, and nearly fills in the entire space. No doubt the passage of a train through a tube of this kind does act with an expelling force upon the air in front and acts by suction to draw in fresh air at the stations; but on a four-track road the passage of one train can do nothing more than produce a certain amount of eddying in the atmosphere and certainly can have no general effect of renewing the whole body of air in the tunnel. At the same time it must be remembered that the problem of air renewal is simplified by the fact that the subway lies very close to the surface, and not, as do the London tubes, 60 or 80 feet below it. The use of electric traction will, of course, preclude any such state of things as revealed by the 89.4 per cent of carbonic acid gas that was found in the steam-operated tunnel of the Metropolitan Railway, London.

LORD KELVIN—ENGLAND'S GREATEST LIVING SCIENTIST.

Although a Scotchman by descent, Lord Kelvin was born in Belfast, in 1824. His father, Dr. James Thomson, was a well-known mathematician in his day, who filled the chair of mathematics both at the Royal Belfast Academical Institution and at the University of Glasgow. From his father the present Lord Kelvin clearly imbibed that taste for mathematics which marks all his scientific investigations. Together with his brother, Thomson studied at Glasgow College. From Glasgow he went to St. Peter's College, Cambridge, graduating in 1845. That his main work at Cambridge was mathematical goes without saying.

Even before his Glasgow student days came to an end, William Thomson's original work in science had begun. His first mathematical papers, written before he entered Cambridge, discussed the Fourier mathematics, then but little known. In 1842, when but seventeen years of age, he published a paper on "The Uniform Motion of Heat in Homogeneous Solid Bodies and Its Connection with the Mathematical Theory of Electricity." Even in that early paper he points out the analogy between certain problems in the conduction of heat and in the mathematical theory of electricity and magnetism; and he shows how to make use of solutions of the one set of problems in order to arrive at important conclusions with regard to the other. The papers which we have mentioned were followed by a treatise on "The Linear Motion of Heat," which contained principles later so powerfully applied to the question of "geological time."

Owing to the very limited amount of space at our disposal it is impossible even to mention the many papers with which Thomson enriched the literature of pure physics. In the early forties electricity was passing through a transition stage. The discoveries of Faraday had opened up an unsuspected field. The function of the dielectric had been discovered and traced out; and the doctrine of lines of force had been expounded. Thenceforth action at a distance, so far as electricity and magnetism were concerned, was a notion of the past—an hypothesis utterly untenable and incapable of representing the facts of the case. Thomson eagerly grasped this truth; and using the new discoveries as the basis of his mathematical investigations, gave to them a mathematical form, which rendered them of practical service to later electricians.

Thomson's early investigations were soon translated into the language of "the potential;" and the connection was established between these results and the theories of energy, with which Joule was just then concerning himself. Thus it was that Thomson, at the early age of twenty-one, become the exponent of doctrines, the full value of which can scarcely be said to have been appreciated until he had reached his fortieth year. In 1867, the word "potential," which is now one of the stock terms familiar to every electrical student, was unknown, except to a few advanced mathematicians.

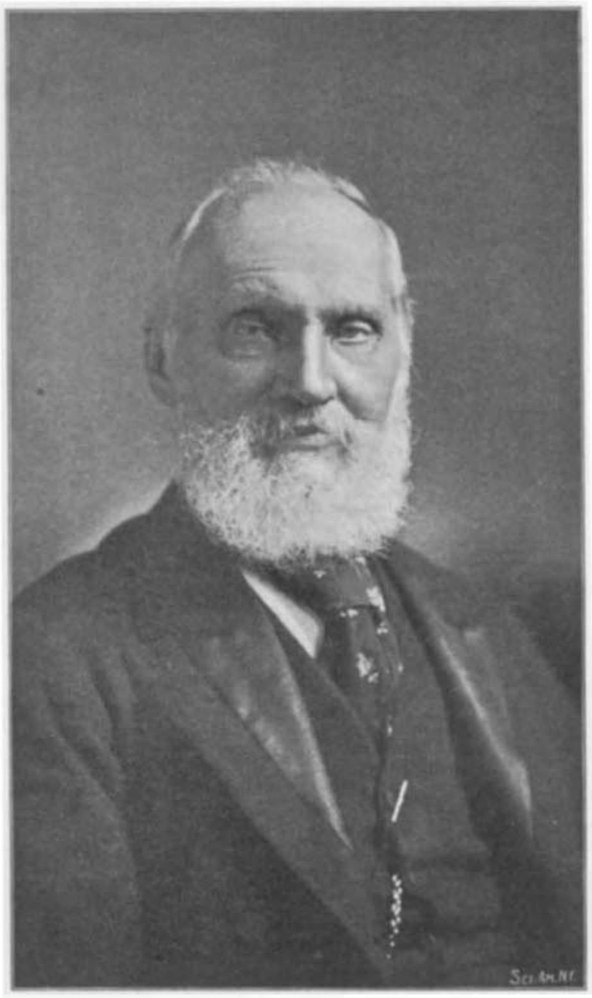
At twenty-two Thomson was elected Professor of Natural Philosophy in the University of Glasgow—a chair which he has filled with honor and distinction up to the present time.

As we have already seen, even in his student days, Thomson had been attracted to the dynamical theory of heat. He was one of the first to appreciate the importance of the work of Joule. One of his earliest papers on thermo-dynamics shows how the theory of Carnot may be adapted to the modern doctrine of heat. Thomson's papers on the subject of thermo-dynamics constitute one of the most valuable and most remarkable contributions made to modern physical science. In 1852 the principle of the dissipation of energy was announced, in connection with which experimental determinations were undertaken both by Joule and Thomson. More than one joint paper of rare value was contributed by these two life-long friends.

In 1855 and 1856, the problem of ocean telegraphy was placed before scientific men for solution. Thomson ardently threw himself into the work and gave to the world the first practical solution. Only a brief account of this, his most important practical work, can here be given.

Following the experiments of Faraday, Thomson had investigated mathematically the retardation of signals, and had formulated the law of squares, now so familiar in telegraphy. When the possibility of laying down a cable across the Atlantic was discussed, he pointed out that a conductor 2,000 miles long, unless of unprecedentedly large cross section, might prove a commercial failure, on account of the slowness of the transmission of signals. The warnings of Thomson were not heeded. It was only when the 1858 cable was completed that the full force of his contention was appreciated. When Whitehouse, Thomson's rival, failed to make good his promises of transmitting messages at a fair rate of speed, Thomson was sent for by the directors of the company, and asked to provide an instrument that would satisfy the conditions necessary for its success.

Experimenting with the reflection of the image of a candle thrown from his concave eye-glass on a sheet of white paper in a fairly lighted room, Thomson judged that the flame of a paraffine lamp reflected from a silvered mirror would give an image bright enough for the convenient reading of telegraphic signals. Such was the germ of the mirror-galvanometer. Mirrors and instruments were soon made; and in 1858 the mirror-galvanometer was successfully applied to the cable. The instrument is the first of Thomson's many inventions. With characteristic generosity he had intended to abandon the instrument to the public, but was finally induced by the company to take out patents. The fruit of his labors in developing the



LORD KELVIN, LL.D., F.R.S., ETC.

sounding machine and the mariner's compass he was also willing to leave unprotected. Sounding by piano wire was offered to the Admiralty, as well as the compass; but he found in each case that the only way of securing public attention to inventions was to patent them and work the patents.

In 1867 the siphon-recorder was invented and patented by Thomson. Three years later it was used on ocean telegraph cables. Up to the present time the mirror-galvanometer and the siphon-recorder are the only instruments by which signals are read on very long submarine lines.

For five or six years he devoted himself to electrical problems of transcendent difficulty. Almost every department of electricity bears the impress of his work. That a scientist of his attainments should have received honors from every country in the world is but a small acknowledgment of the valuable work he has done in modern science. He succeeded Sir George Gabriel Stokes as president of the Royal Society in 1890, and was created first Lord Kelvin in 1892. He is a Fellow of almost every scientific society of note throughout the world, bears degrees conferred upon him by half the universities of Europe, and has received numerous medals for his eminent inventions and discoveries. The present is not Lord Kelvin's first visit to this country. In 1876 he was a judge at the Centennial Exhibition. In 1884 he visited America to attend the Montreal meeting of the British Association. In 1897, the date of his last visit, he attended another meeting of the British Association held at Toronto.

THE HEAVENS IN MAY.

BY HENRY NORRIS RUSSELL, PH.D.

In concluding our description of the zodiacal light last month, we referred to the fact that, under favorable conditions, it can be seen to extend entirely across the sky as a very faint band of light which, in the region that lies opposite the sun, brightens into a faint spot of light.

This spot is commonly known by the German name Gegenschein—a *glow* in the sky.

The Gegenschein is one of the faintest objects known; yet it is easier of observation than has often been supposed.

The observer should glance rapidly across the sky from the zenith to the horizon. A few such sweeping glances will probably convince him that there is a region some distance above the horizon where the background of the sky is sensibly brighter than in the regions above or below it. This region lies at present in the constellations of Virgo and Libra. He should now repeat the process, sweeping the sky from right to left, along the brighter region previously noticed, when he will probably see that a certain region is brighter than those to the right or left of it. It can best be studied by glancing across it from one side to the other, rather than by looking directly at it.

The position of its center among the neighboring stars may now be estimated, and if this position, when looked for on a star map, lies near the ecliptic, and about 180 deg. from the sun's place on it for the day of observation, the observer may be sure that he has seen the Gegenschein.

THE HEAVENS.

At 9 P. M. on May 15 Cygnus is rising in the northeast. Above it, on the right, is Lyra, and Hercules is farther on in the same direction. The brilliant Arcturus high up on the southeast of the zenith, marks the position of Bootes, and the little circlet of corona lies between it and Hercules. The intertwined constellations of Ophiuchus and Serpens fill the large area below them, while the red Antares, low in the southeast, shows that Scorpio is rising there.

Virgo lies south of the zenith, its brightest star, Spica, being nearly on the meridian. Libra lies between Virgo and Scorpio. Leo is southwest of the zenith, and Hydra stretches its ungainly length below it. Canis Minor, Gemini and Auriga are near the western and northwestern horizon.

Ursa Major is above the pole on the left, and Draco on the right, while Cassiopeia and Cepheus are below the pole, near the northern horizon.

THE PLANETS.

Mercury is evening star throughout the month. At first he is too near the sun to be seen, but later on he is remarkably well placed for observation. His distance from the sun is greatest on the 28th, when he sets two hours and twenty minutes later than the sun. He can therefore be well seen in the northwest, much less involved in the twilight than usual.

Venus is conspicuous as a morning star, rising about two hours and a half before the sun.

Mars is also a morning star, but is still too near the sun to be observed.

Jupiter is morning star in Capricornus. On the 6th he is in quadrature with the sun, and is due south at 6 A. M.

Saturn is morning star in Sagittarius and is due south at 4 A. M. in the middle of the month.

Uranus is in Ophiuchus, coming to the meridan at 1:40 A. M. on the 15th. Neptune is in Gemini, too near the sun to be seen.

THE MOON.

New moon occurs on the afternoon of the 7th, first quarter on the morning of the 14th, full moon on that of the 22d, and last quarter on that of the 30th.

The moon is nearest us on the 8th, and farthest away on the 23d.

She is in conjunction with Venus on the 4th, Mars on the 7th, Mercury on the 8th, Neptune on the 10th, Uranus on the 23d, Saturn on the 27th, and Jupiter on the 28th. On the 19th there occurs an occultation of the bright star Spica, in Virgo. As seen from Washington, the star disappears behind the moon's dark limb at 1:48 A. M., and reappears at the other side of the moon 47 minutes later. This interval will be longer for places north of Washington, and shorter for those south of it.

On May 7 there occurs a partial eclipse of the sun. As it is visible only in New Zealand and the Pacific Ocean south and east of it, it is of little importance to us.

Princeton, N. J., April 19, 1902.

Captain Morse, Chief Signal Officer of the Department of California, has received orders from the War Department to open negotiations for the installation of a system of wireless telegraphy between army stations in Alaska.