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ATMOSPHERIC RESISTANCE TO RAILROAD TRAINS.

In our issue of July 15, of last year, we illustrated and commented at considerable length upon the remarkable speed of over sixty-two miles made by a bicyclist paced by a locomotive over a mile of measured track. In speaking of the lessons in air-resistance taught by this performance, we referred to the proposal of Mr. F. U. Adams to sheathe a railroad train, and give it a cross-section similar to the shield used in this bicycle trial—this with a view to proving the correctness of his theory that atmospheric resistance could be greatly reduced, and the speed proportionately increased, by building a train with something of the wedge-shaped ends and smooth and continuous lines that characterize the models of steamships.

Thanks to the enterprise of the Baltimore and Ohio Railroad, a full-sized train has been equipped on the lines suggested, and a series of trials is now being made under working conditions, and under a system of chronometer timings which should preclude all possibility of error. On another page will be fonnd an illustration of the train and an account of the trial run of forty miles between Baltimore and Washington. We are free to confess that, unless there has been some error in the timing or the distances, the results are without a parallel, and may be taken as establishing a record in high-speed railroad travel.

While it is true that forty miles has, on other occasions, been run at a higher average speed than sixty-four miles an hour, the record has never been made under such unfavorable circumstances. The present run was made from start to stop with one slow-down to twenty miles an hour, and the line, on account of its grades and curvature, is not to be compared with the straight and level stretches of track over which phenomenal speeds have been hitherto attained.

The most surprising records on this trial (which are such as may well strain the credulity of railroad men) were obtained over the 20·1 miles from Annapolis Junction to Trinidad, which were covered at the rate of 78·6 miles an hour. This would be a remarkable performance for a 57-ton engine if it were hauling a train of 170 tons over a level road; but when we bear in mind that the first 7 miles was on an up-grade of from 25 to 55 feet to the mile, and that to maintain the high average the last 5 miles of downgrade was run at the rate of 102·8 miles per hour, it is evident that some abnormal conditions must have been present to render such a feat possible. There is no authentic record of such a speed having been attained, even for one mile; for although a speed of 112 miles an hour was claimed to have been made by the Empire State Express, the officials of the New York Central Road have rejected the record as being doubtful.

It has been pointed out by Mr. Rous-Martin, who spends most of his time upon the footplate of express engines, and is the accepted authority on the subject, that a liberal percentage must be deducted from most of the so-called record speeds of trains (particularly where the distances are a mile or less than a mile in length), because an error of a very small fraction in the timing will make a very large error in the estimated speed per hour. We are informed by Mr. Adams that error was guarded against in the case of the Baltimore and Ohio train, by providing five timekeepers and taking the average of the times recorded by the stop watches as each station was passed. There was a close agreement between the watches as to the time occupied in running from Alexander Junction to Trinidad, and if the distance is, as stated, exactly five miles, the record of over 100 miles an hour must be taken as established.

The results of this most interesting experiment are not so surprising, if we bear in mind what the windshield has done for the bicyclist. The fastest riders can barely cover a mile, unpaced, in two minutes; but with a moto-cycle to pace him a rider has made the distance in one minute and nineteen seconds, and behind the more complete shelter of a locomotive and car the mile has been done in fifty-seven and four-fifths seconds. It is natural to suppose that by smoothing out the train, as it were, and preventing the air from closing in upon platforms and trucks, a proportionate increase of speed would be realized. At the same time it cannot be denied that the results are so unprecedented as to lend extraordinary interest to the trials which have yet to be made.

THE TOTAL ECLIPSE OF THE SUN.

It is safe to say that the total eclipse of the sun of May 28, 1900, has attracted more attention, at least in the United States, and been more widely observed by both professionals and amateurs, than any previous eclipse. The increasing interest in this always instructive phenomenon and the great improvement in the modern instruments for taking accurate observations account for much of this, but the main and controlling reason was the convenient locality of the moon's shadow on the surface of the earth, generally known as the path of the eclipse. This path extended in an almost straight line about 50 miles in width from the southeastern part of Louisiana to the capes of the Chesapeake, passing over portions of Louisiana, Alabama, Georgia, North and South Carolina and Virginia, including New Orleans and other cities of our Southern States. This location of the path of the sun not only afforded to the inhabitants of this section of the country an easy opportunity to see the eclipse, but made excursion parties a special feature of the occasion, and the President left Washington on the dispatch boat "Dolphin" with a party in order to view the eclipse near Norfolk, Va.

There was, however, nothing novel or striking in the general nature of the eclipse, and it resembled in many respects its immediate predecessors. The corona was very similar to those of the eclipses of 1878 and 1889, and like them extended on one side of the sun in the shape of a long pointed streamer, and on the other side like an enormous fish tail, in the extreme end of which was the planet Mercury. It has also been described as consisting of three principal streamers of about equal length, and one of about half the length of the other three, and of curved rays from the poles of the sun, which were very conspicuous. Another observer says that he saw fifteen streamers in the north polar region of the sun, of even and regular structure, with bright centers. In the south polar region the streamers were rolling from a point not near the center of the sun, but near its limb, and were of a finer structure, and some of them crossed.

The corona was bluish green in color, and some described it as having a silvery hue. The solar prominences or the chromosphere, instead of the usual carmine or light crimson, was remarkable for being light pink, which, according to Prof. Eastman, is a very unusual thing.

One reason given for the great similarity of the corona in the eclipses of 1878, 1889 and 1900 is the fact that these years were all years of minimum sun spots, and it is supposed to bear out the theory that a relation exists between the sun spots and the corona.

But while the corona was a beautiful and awe-inspiring sight, it was not considered to have equaled its predecessors. It was fainter than in 1878 and dimmer than usual; the prominent white places were entirely wanting and the streamers were not quite as active as formerly.

SCIENTIFIC TRANSLATION.

Glancing over the list of scientific books which are published each year in ever increasing numbers, one finds that not a few of them are translations of German and French works, which have been deemed of sufficient importance and value to warrant a reissue in England or the United States. The introduction to English-speaking scientists of works whose writers are respected as authorities is undeniably praiseworthy; but the ragged English in which the thoughts of these foreign authors have been clothed must give us pause and cause us to reflect whether engineers and chemists would not do well to brush up their German and French, mildewed by long disuse, and to read in their undefiled native language those works which are now presented in uncouth dress.

The translation of a scientific treatise is both more difficult and more readily accomplished than the translation of a novel or essay; more difficult because it requires in addition to a mastery of two languages, a reasonably thorough knowledge of the subject under discussion; more readily accomplished because elegance of expression must give place to accuracy of translation. Indeed, exactness is the prime requisite of a rendering of a foreign scientific work.

But sometimes it happens that a scientific writer is not only a man of thought, but also a man of considerable literary ability, who clothes his thought in phrases and sentences artistically formed and grouped. The translation of the writings of such a man, ceases to be merely an intellectual task; it becomes an undertaking in which the feeling and good taste of the translator are called into requisition to reproduce as faithfully as possible the style as well as the intellectual traits of the original. A Frenchman, who would construe into his mother-tongue the lectures of Huxley and Tyndall, would seek to convey in his version something more than the mere thought of his original. He would endeavor to reflect the style as well—not that he would ever fully succeed, for the idiomatic grace of one language can never find an exact counterpart in another; but he would deem it necessary to convey to his readers something of the color, the music, and the suggestiveness of the English work. In short, he would attempt to reproduce the man, even to his mannerisms, as well as the thought of the man.

That most scientific translators fail to catch the style of the foreign author is too often due to a deficient knowledge of their own language. A well-known and most successful translator of novels, a woman who has presented to Americans many of the most popular works of German fiction, once remarked: "Anybody can find out the meaning of a French and German text; that is simply a matter of using a grammar and a dictionary. The secret of making an acceptable translation lies in the ability to express that meaning in good English."

But granting that the dictionary is a matter of secondary importance to the translator of novels, it can not be denied that it is well-nigh indispensable to the man who is rendering into English the works of a foreign scientist. As the late Master of Balliol was wont to say, no one is infallible,—not even the youngest of us. No translator can be expected to know the English equivalent of every foreign technical term; he must of necessity have recourse to a good lexicon in which he is sure to find reasonably accurate translations of technical phrases. But unfortunately the dictionaries at present in use are most dangerous things. That they are for the most part old is pardonable; but that their definitions should often be inadequate and sometimes inaccurate is inexcusable.

Few works become so quickly antiquated as scientific dictionaries. An invention frequently requires the coining of an entire terminology to define the new contrivance and its functions. The introduction of the phonograph and telephone, the invention of the steam engine and dynamo-electric machine, the discovery of the Roentgen rays, have each been the means of enriching our scientific vocabulary with words that have been immediately seized and absorbed in the technical speech of the day. Although of new mintage, these terms are as commonly used as any in ordinary mechanical parlance. Obviously the dictionary in which they are not contained is incomplete. And yet most of the purely technical dictionaries are so lamentably deficient in this respect that, for example, many of the terms used in electrical engineering for the last fifteen years, find no place in their pages. For this reason the task of the scientific translator is rendered doubly difficult. In order faithfully to render a scientific treatise into English he must, in a measure, be independent of the lexicon; he must be sufficiently conversant with the topic under discussion to supply, when his dictionary fails him, a correct translation of a term, and to select from a number of meanings that which adequately fills his needs. We shall not readily forget a translation of an article on a German airship, published in a prominent American newspaper, in which the German word for "car" (Gondel) was literally translated by "Gondola," an example either of a too slavish adherence to the original or a lack of judgment on the part of the translator.

The habit of consulting a good technical dictionary is one of the means of cultivating a nice appreciation of distinctions in scientific synonyms. One acquires, moreover, an excellent understanding of the possibilities of one's mother tongue as well as a knowledge of its defects and of its advantages over other languages. The English translator will tell you that, of all languages, French is the most idiomatic; German the least. And although he has not the blessed German privilege of compounding words *ad libitum* to meet his special requirements, he rejoices in that wealth of synonyms which enables him to render a foreign sentence into good Anglo-Saxon with much of its original vigor and idiomatic connotation, and to give to his translation all the marks of an English work, with no trace whatever of the foreign idiom.

THE CENTRAL LONDON TUNNEL ROAD.

A number of details have been recently published as to the new underground electric railway of London. This road, which is called the Central London, commences in the city, near the Bank of England, at a point where the circulation is greatest; it traverses the city in a nearly straight line, its route following mainly Holborn and Oxford Street, ending at Shepherd's Bush, not far from the Uxbridge Station of the Metropolitan; it has 12 intermediate stations. The line is formed of two tunnels, with metallic lining, at 80 feet below the street level, having an interior diameter of 11 feet. At the stations the tunnels are enlarged to 20 feet diameter over a length 370 feet. The stations are reached from above by three pits; one of these is 18 feet in diameter, and has a spiral staircase, the two others, of 23 feet diameter, being each provided with two electric elevators, these having a capacity of 100 persons each. The tracks of the road are laid with steel rails of 100 lb. to the yard; a third rail placed in the center serves to bring the current for the motors.

The road now has 32 locomotives, and the trains are made up of 7 cars, carrying 336 passengers. The weight of the train, without locomotive, is 105 tons, the latter weighing 42 tons. The average speed is 14 miles per hour, with stops of 20 seconds at the stations; a maximum speed of 30 miles is allowed. The trains follow each other at intervals of 2½ minutes, and this is reduced to 2 minutes at times of greatest traffic.

The profile of the road presents the peculiarity that each station occupies a level between two grades, ascending and descending, of 3 per cent. This gives a diminution of speed upon arriving, and on the other hand makes it easier to start the motors on leaving the station; this arrangement gives a considerable economy of current. The central station is located at Shepherd's Bush, and supplies three-phase current at a tension of 5,000 volts; this is transformed in four sub-stations to continuous current at 500 volts for the motors. The locomotives have two trucks, each of which is provided with two motors. The current is taken by rubbing contacts upon the central rail. The annual expenses of operation are estimated at $660,000, this being made on a basis of 2½ minute intervals for the trains.

SMELTING PROCESS FOR ZINC ORES.

The zinc industry has been brought prominently before the public by the promotion of many companies to operate the rich mines of the Joplin district of Missouri and Arkansas, a profitable state of affairs having resulted from the ore producers' combining and dictating prices to the smelters. It happens that the Joplin mines produce over 60 per cent of the world's output of zinc ores which can be reduced economically by present methods. From the standpoint of scientific smelting, zinc occupies a most unsatisfactory position. The reduction of its ores is accomplished by processes "just as clumsy as they were when Paracelsus described them more than three hundred years ago." Arthur Winslow states in an article upon the lead and zinc industry of Missouri, that in making zinc upon a large scale about 25 to 30 per cent of the metal is lost, and that it takes 3 tons of ore averaging from 45 to 50 per cent of zinc, 6 tons of coal, and 700 pounds of refractory materials to yield 1 ton of zinc. The present methods require rich ores which are first roasted to transform their zinc compounds into oxide. The calcined ore is mixed with coal and loaded in small charges into clay retorts which are placed, many at a time, in a special furnace. Upon heating, the zinc is produced and volatilized, the vapors being led to condensing apparatus by suitable connections with the retorts. This laboratory method has to be employed because the temperature of reduction of zinc oxide and the boiling-point of zinc at atmospheric pressure differ by but a few degrees. Many endeavors to produce zinc, like iron, lead, and copper, in a blast-furnace have failed, the metal being vaporized and lost with the gases as zinc dust, a mixture of zinc oxide and finely divided zinc.

There exist throughout the West unlimited deposits of sulphureted zinc-lead ores, carrying generally a small amount of silver. They are cheap but refractory. An easily available ore of this nature contains 20 per cent lead, 30 per cent zinc, and 40 ounces of silver per ton. At the present day these ores are utilized by the lead smelters. In the ordinary way of lead smelting rich ores are required. These being rare and the competition keen, the smelter has to purchase them at prices not only leaving no profit but mostly entailing actual loss. To counterbalance this loss there is included in the furnace charges as much of the cheap, refactory ores as can safely be added. Yet, in the present method of smelting, not only is the whole of the zinc lost, but its very presence causes great losses of lead, silver, and gold, partly due to the formation of flue dust and partly by the production of a viscous slag rich in zinc. In purchasing these ores the smelter does not pay for the zinc and deducts, moreover, 50 cents per ton from the price established by the amount of lead and precious metals for each per cent of zinc above 10. As the zinc passing into the slag renders them very viscous, the smelter can only add as much as is compatible with economy. It is not good practice to have more than 7 per cent of zinc in the slag. On this basis the quantity of zinc lost in slag in the United States amounts to more than its total annual production.

Dr. Emil E. Lungwitz, a mining engineer of considerable experience, has invented a process for the smelting of these refractory ores and the recovery of practically all the contained metals. It merits attention because it rests upon a sound, scientific foundation, and the facts involved have been established by careful experiments made in the laboratory of the Royal Polytechnic School of Berlin by Dr. Lungwitz and Dr. R. C. Schüpphaus. The process is based upon the fact that the boiling point of a liquid is an increasing function of the pressure. Dr. Karl Barus has determined the most reliable figures with regard to zinc, and states that in the neighborhood of atmospheric pressure, the temperature increment of the boiling point of zinc amounts to 1·5° C. for each additional centimeter of mercury pressure. Briefly, Dr. Lungwitz proposes to smelt zinc ores in a blast furnace under pressure sufficient to keep the zinc liquid at the temperature of the furnace and to withdraw it in such a manner that it will have a temperature below its boiling point under atmospheric pressure when it reaches the receiving vessels. The objection occurs at once that bulky constructions like blast furnaces do not lend themselves to designs involving high internal pressures. Dr. Lungwitz, however, is convinced that a pressure of three atmospheres is amply sufficient. The facts to support this are: The temperature of reduction of zinc oxide by carbon is 910° C., and the boiling point of zinc under one atmosphere is 930° C. Dr. Barus estimates the boiling point of zinc under five atmospheres pressure to be 1,500° C., a temperature known to be entirely out of the question for the melting of either lead or zinc ores or a mixture of both. The temperature of a slag formed in a lead stack was found by Malvern Iles to be 1,034° C. The melting point of diabase is not higher than 1,170° C., according to Dr. Barus, and no blast furnace could ever be run on a slag of similar composition. In the experiments of Dr. Lungwitz and Dr. Schüpphaus, a crucible supported and surrounded by fireclay bricks was placed in a strong cast-iron vessel provided with a bolted cover. The high temperatures needed were obtained by heating to incandescence by an electric current a platinum wire strung up and down through perforated rims on the inside of the fireclay cylinder into which the crucible fitted. Temperature measurements were made with a Le Chatelier thermo-couple carried in a porcelain tube dipping down into the top of the crucible. Pressures were obtained by forcing air in by a small compressor. A gage and safety valve were also attached. There were obtained in this apparatus ingots of zinc at the bottom of the crucible when a mixture of pure zinc oxide and carbon was heated under a gage pressure of 45 pounds per square inch to 1,150° C., a temperature some 200° C. above the ordinary boiling point of zinc.

Conditions are yet more favorable in smelting the sulphureted zinc lead ores. Taking the temperature of lead furnace at 1,056° C., the tension of zinc vapor for that temperature is under two atmospheres, as given by the figures of Dr. Barus. In addition, lead and zinc alloy with avidity at red heat and the osmotic pressure exerted under these conditions will aid to prevent the ebullition of the zinc. The separation of these metals is most easily effected by cooling, for at temperatures in the neighborhood of the melting point of zinc (415° C.), lead combines with but a few tenths of one per cent of zinc, no matter how carefully the mixture is stirred. These facts show the feasibility of Dr. Lungwitz's process and prove that the conditions of operation will lie entirely within practical bounds.

There have been experiences in smelting work which show that the accidental establishment of these conditions has led to the delivery of zinc in small quantities, when zinciferous ores have been made use of. The Rammelsberg smelters, in the Hartz Mountains, sold, forty years ago, zinc that had been tapped from lead blast furnaces, the quantity obtained at each tapping varying from 0·5 to 5 pounds. Then an improvement called the zinc shelf was introduced to condense the zinc vapors, and what was obtained was found very rich in lead and was produced under the conditions of a reducing atmosphere, at a low temperature as compared with modern practice, and under a slight excess of pressure. The New Jersey Zinc and Iron Company utilize a zinciferous iron ore by first vaporizing and oxidizing the zinc and then smelting the residues from iron. These residues contain at least 3 per cent zinc, and it frequently happens that when the furnace cools off considerably and the pressure of the blast rises, establishing conditions favorable to the formation of liquid zinc, quantities of from 400 to 500 pounds of metallic zinc have been tapped together with the iron. These and similar observations were investigated carefully by Dr. Lungwitz, and he concludes: "From these actually observed cases of condensation of zinc in blast furnaces, under widely differing conditions, we may conclude that the forces favorable to the liquefaction of the zinc are pressure in the furnace and chemical affinity."

Dr. Lungwitz has proved his case up to the point of actual trial in a large furnace. This will be done before the year is out. It is expected that no flue-dust will be formed during the trial, by reason of the high-pressure blast which will be employed.

An interesting chemical point in connection with the experiments of Dr. Lungwitz and Dr. Schüpphaus in their laboratory furnace was the formation on different occasions of a powder of a canary-yellow hue which contained by chemical analysis more zinc than belongs to ZnO. Pursuing the idea that this yellow compound might be a low oxide of zinc, they made the following experiments, each yielding a body permanently yellow. Zinc oxide was heated in an atmosphere of pure nitrogen; zinc oxide was heated in vacuo; zinc oxide mixed with zinc dust was heated under pressure. The investigators concluded: "These experiments render it highly probable that zinc oxide on heating loses part of its oxygen and that the new compound is stable if it is cooled in the absence of oxygen." The matter is being thoroughly investigated by Prof. v. Knorre, of the Berlin Polytechnic School.

A NEW TELE-PHOTO LENS.

Although the tele-photo lens has been before photographers for about ten years it has not come into anything like general use or acquired the popularity that it deserves. Two causes have contributed to this: the general belief, derived from its name, that it is only adapted to photography at long distances, and the fact that with the tele attachment, very much longer exposures are necessary than with the normal lens without it.

All this is now likely to be changed and the tele-photo lens given a fresh start, T. R. Dallmeyer having patented an arrangement in which the complete enlarging system may be as fast as the ordinary lens alone, and the users of hand and other small cameras may avoid the usual "exaggerated perspective" by getting at a greater distance from the foregrounds, and at the same time secure any desired size of image.

The new tele attachment consists of two lenses, a positive and a negative, one in each end of a sliding tube, and placed in front of the ordinary lens, generally screwed into the place of the hood. The outer or positive lens is of the highest possible intensity, that is, of as large a diameter and short focus as may be convenient; the inner or negative should be of shorter focus than the ordinary lens, and its power should be at least equal to the sum of both.

When the lenses of the tele attachment are at their normal distance apart, that is at a distance equal to the difference of their focal lengths, parallel rays incident on the outer or convergent lens are sent converging to the inner, the diverging, and by it transmitted parallel to the ordinary lens. If this has been focused for parallel rays, as is the case with so-called "fixed focus" cameras, the image of the complete system will be formed at its focal plane, just where it would be without the tele attachment, but with considerable magnification.

Placed more closely together, the converging rays from the positive lens are, by the negative, transmitted to the ordinary lens at an increased degree of divergence, forming a larger image, larger in proportion to the decrease of the distance, but coming to a focus at varying distances beyond its focal plane.

When the elements of the tele arrangement are separated to distances beyond their normal, their action is reversed; rays reach the ordinary lens in a convergent form and come to a focus within its focal plane; but the intensity is considerably increased, that is, the system now is faster than the ordinary lens without the tele arrangement.

In connection with this, it may be interesting to know that not to Barlow, in 1834, as is generally supposed, are we indebted for the original tele-photo lens, but to R. P. F. Joannis Zahn, in 1686. Dr. Von Rohr tells The British Journal of Photography that he recently unearthed a book by that old scientist, in which he describes and illustrates "A special combination of a concave and convex lens for producing a larger image," and drawing and description are as applicable to the modern tele-photographic lens as though they had been made yesterday; the only difference being that his lenses were not corrected, while those of the modern instrument are.

THE LATEST DEVELOPER.

A new developer has lately appeared which is said to give good results and the equal, if not superior, to hydroquinone. The body which has received the name of adurol is a derivative of hydroquinone, and seems to have all the good properties of that developer, without its defects. It requires but a small quantity of alkali, and the potassium carbonate may thus be replaced by sodium carbonate, which is less corrosive, while the use of caustic alkali becomes necessary. In spite of the small quantity of alkali, the image comes up more quickly than with hydroquinone, and it is also to be remarked that low temperatures have no appreciable influence in retarding the development of the image or details. The principal quality of adurol is its great developing power, which is not equaled by hydroquinone even with the use of caustic soda; it has the valuable property of working up to the end of the development without causing fog upon the plate, which renders it superior to many other developers in this respect. The image appears normally in about 20 seconds and the development is regular and uniform; after about 4 minutes it has gained the desired intensity. The reduction of silver takes place not only in the strongly exposed parts, but in the details, which come up regularly as the development proceeds; in this way the final results is a plate which presents a harmonious appearance, rather soft than hard in quality. It is apparent that audriol may be used with shorter exposures then when hydrochinon is used, and may thus be of value for exposures by dim light, for rapid instantaneous work, X-ray exposures, etc. Bromide of potassium is an excellent retarder for this developer, but it may be used in smaller proportion than usual.