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THAT AIR RESISTANCE PROBLEM.

Our discussion of the air resistance problems involved in the recent bicycle ride, paced by a locomotive, has brought to the editor's desk a considerable amount of correspondence and a varied assortment of theories. Most of the writers of these letters are laboring under a common delusion with regard to the nature of the assistance rendered by the locomotive, or by any form of "pacing" machine, mechanical or human, to the rider who follows it. The error is aptly expressed in the letter of a correspondent which we publish in another column, where he says, "if Murphy had taken his feet off the pedals after he had attained his maximum speed, he would have finished just as soon as he did," for the reason that the "suction or inrush of wind behind the train," amounting to "seven horse power of wind at his back," drove him along the track and rendered all exertion on his part superfluous. Our correspondent is by no means alone in his belief that the rider, to use a common expression, was "sucked along" behind the train, and *nolens volens* had to follow it at a speed of over 62 miles an hour.

Perhaps the best way to realize the nature of the assistance rendered to Murphy by the locomotive is to consider the conditions if he were to ride over the course at his fastest speed without pace. The resistance when he had reached full speed, supposing the track to be level, would be made up of the rolling resistance between the tires and the track, the internal resistance (friction of bearings, etc.) of the bicycle, and the air resistance. If our readers will turn to our article on this subject in the SCIENTIFIC AMERICAN of July 15, they will find two diagrams which show that the loss by friction in a special racing bicycle is only from one to five per cent, being less the greater the work that is being performed; and that with highly inflated tires the work absorbed in overcoming rolling resistance is also reduced to a minimum, especially on a smooth board track, such as that on which the trial was made. This leaves the air resistance as the chief obstacle to speed.

Let us suppose that he could ride the mile, unpaced, in two minutes, or at the rate of 30 miles an hour, and that the disturbance caused by his passage through the atmosphere were made visible by some system of coloring, the still air being colorless and the moving air colored. We should then find that a blunt wedge-shaped mass of rather dense air was pushed forward in front of him and a longer wedge of slightly rarefied air was drawn forward after him, the base of the wedge being of course in each case at his body. The rider in addition to the air carried before and behind him would also be surrounded by an envelope of eddying air, moving forward with him but at a greatly reduced speed. The sum total of the resistance of the atmosphere to the movement of the rider and the air which he carried with him, would be found to average so many pounds to the square foot, assumed in our article as equivalent to 15 pounds on 3 square feet of surface normal to the direction of travel.

Now in the case of a locomotive and car moving at 60 miles per hour, there would be the same piling up of the air in front and the same wedge of air following behind, and the same enveloping mass of air moving forward with the train at a slower speed. Speaking of the air which follows the car, we may say that relatively to the board track over which it passes, it is a 60-mile wind, and relatively to an object which, like Murphy, is moving within it at the same speed as itself, it is practically still air. As long as Murphy rode within this wedge of air, his exertions were directed solely to overcoming the internal resistance of the wheel and the rolling resistance of the tires on the track. For it is evident that the wedge of air, moving at the same speed as himself, could neither offer resistance from the front nor exert pressure from behind. The only way in which he could have experienced the pressure of a "60-mile wind behind him to carry him along," would have been by his motion being arrested, and the rush of air would last only until he had dropped out of the moving wedge of air that followed the train and the more slowly moving envelope which closes in and follows after it.

Another correspondent fails to understand why the air behind the moving car should assist the bicyclist and yet exert a retarding effect on a car in the same relative position and forming part of a train. The explanation is to be found in the difference of area of the bicyclist and the front face of a following car. Murphy, representing 3 square feet of area, could move back several feet from the rear of the shield and yet be within the wedge of moving air, but a car with its front area of say 80 to 90 square feet would expose a large percentage of its surface outside of this wedge, all of which exposed surface would offer resistance to the atmosphere, or, to speak more correctly, its passage would be resisted by the atmosphere.

A correspondent, whose letter is given elsewhere, assumes that the "body of air enveloping the entire train is swept along with it at about the same rate of speed," and, therefore, "small projections . . . add little or nothing to the resistance." In this we think he is entirely wrong. The action of a train on the air is fairly analogous to that of a ship on the water, where "skin friction," or the resistance of the surface of the hull to the sliding contact of the water, is so serious an element that yachts are built of costly alloys in order to reduce skin friction to the limit. The train does draw with it an envelope of air, but its speed is far below that of the train, and every projection on the latter, to say nothing of the broad front faces of the cars, adds to the retarding effect enormously.

ANNUAL REPORT OF THE COMMISSIONER OF PATENTS.

The Annual Report of the Commissioner of Patents cannot fail to produce general satisfaction, particularly when it is learned that some greatly needed reforms in the matter of the system of classification, which have been urged both by former Commissioners and the present incumbent of the office, have been at last carried out. This work is spoken of by Commissioner Duell as "the most notable advance of the year in the work of the office."

"The crying need of this bureau," says the Commissioner, "is for more room," This has been the plea of successive Commissioners for several years, and it is one which this journal has persistently urged on behalf of the vast commercial interests which have their root in the United States Patent Office. The building which was erected for and named after this bureau has been given up largely to the accommodation of the General Land Office, with the result that the overcrowding of the Patent Office has become notorious. The request of the Commissioner that "when the General Land Office vacates the Patent Office building," the Secretary of the Interior "will assign rooms sufficient for the needs of the bureau," finds emphasis in the vexatious delay to which the patrons of the Patent Office have so long been needlessly exposed.

Another crying defect in the accommodations of this bureau is that the priceless records of the office are stored in rooms which are in no sense fireproof—a fact which, if it were not so widely known, would at this late day seem almost incredible. The public will fully indorse the Commissioner when he says, "In view of the fact that millions of dollars of property would be jeopardized by the destruction of our assignment records—many of the original assignments having been lost by their owners, who depend upon duly certified copies—and in view of the fact that many of our other records are largely of a nature that money could not replace, I believe that a fire-proof structure should be provided in which to store them."

The summary of the operations for the fiscal year shows that 41,930 applications and caveats were received, and that the patents granted and trademarks, labels and prints registered numbered 25,404. The number of patents that expired was 16,670. The total receipts of the office were $1,209,554.88; the total expenditures were $1,148,663.48, the surplus turned into the Treasury being $60,891.40. A comparative statement of receipts and expenditures for the past decade shows that the total receipts were $12,700,977 and the total expenditures $10,971,338, making a total surplus of $1,729,637 in ten years.

A significant indorsement of the valuable work done in the new classification, to which reference has been made above, is found in the table showing the number of applications awaiting action on the part of the office in each year of the past decade. Commencing with 6,585 cases in 1890, the total rose to 9,447 in 1892 and then fell to 4,927 in 1895. It had doubled in the following year, and rose to over 12,000 in 1897 and 1898. By June 30 of this year, thanks to the working of the new system and an increase of the force of examiners, backed by a more liberal appropriation, the number of applications awaiting action had fallen to 2,989, a decrease of over 75 per cent.

As the result of the Spanish war the total number of applications, which in 1897 had risen to 47,747, fell in 1899 to 40,320, the smallest record for the decade being 39,206 in 1894. The present indications, however, show a steady increase in the business of the bureau.

EXPORTATIONS OF WHEAT FLOUR.

The millers of the United States have made their greatest record in the fiscal year 1899. While it is true that wheat, corn, oats, cornmeal, rye, and, in fact, all other lines of breadstuffs show a reduction of exportation on account of the decreased demand abroad, flour alone shows an increase which is a phenomenal one. For the fiscal year the total exportation of flour is over 18,000,000 barrels, representing over 80,000,000 bushels of wheat. The exportation of flour from the United States has made its chief development since 1875. Prior to that date American millers followed the old processes in the manufacture of flour, where European millers were experimenting with, and bringing to success, the modern roller-mill methods. As a result, the foreign flour trade of the United States met with serious reverses during the period from 1850 to 1875, the European consumers preferring to buy their wheat and make it into flour with their new processes. In 1854, according to a prominent American miller, we sent 1,846,000 barrels of flour to Great Britain alone, while in 1865 only 200,000 barrels were sent to all Europe. During the period 1825 to 1830, over 99 per cent of the value of wheat and flour exports was flour; in the five years 1870 to 1875, only about 27 per cent of wheat and flour exports was in the form of flour. In 1875 the exportation of wheat flour was 3,973,128 barrels. In 1880 it was almost double. In 1885 it was nearly 11,000,000, and in 1895 it had risen to 15,268,892, while in 1899 the figures were 18,300,000 barrels. This is a most gratifying increase and is in the line of our success in the exportation of manufactured articles. It is especially pleasing to note the quantity of flour sent to the Orient; in 1889, 378,634 barrels were sent to Hong Kong, and in 1899 over 1,000,000 barrels were sent. Germany is also becoming a good customer for flour, and we are now sending her 500,000 barrels against 13,000 barrels ten years ago. The Netherlands are also taking 1,000,000 barrels, an increase of 900,000 barrels in ten years. To the United Kingdom our exports of flour in 1889 were 5,271,244 barrels, and in 1899 they will exceed 10,000,000 barrels. That flour exports should have continued to increase in the face of the reduction of our exportation in other lines of breadstuffs is especially gratifying to those interested in seeing American labor participate as much as possible in the profits of American foreign trade.

THE HEAVENS IN AUGUST.

BY GARRETT P. SERVISS.

In August evenings one looks directly south to see the crossing place of the Zodiac and the Milky Way. The line of the former is indicated by the constellations Scorpio and Sagittarius. The red star Antares, with its third magnitude white attendants, one on the west and the other on the east, marks the heart of Scorpio; while Sagittarius, further to the left, is recognizable by the figure called the Milk Dipper, with its bowl upside down, in the streaming Galaxy. Falling from near the zenith, in immense luminous sheets, whose soft glow recalls the appearance of such a cataract as the Staubach when its descending clouds of water-dust are gleaming in the moonlight, the Milky Way justifies the rhetorical figure, often applied to it, "a river of stars." Its brightest portion runs from Aquila, whose chief star, Altair, has two attendants resembling in position those of Antares, down through the little constellation of Scutum Sobieskii, where it breaks into silvery flakes of wonderful beauty, and then descends to the southern horizon across the western part of Sagittarius, while a kind of setback from the main current overflows the eastern region of Scorpio, and the feet of Ophiuchus above. It is the California of the sky, packed with the riches that the star-gazer seeks with his telescope.

While the south glows with these splendors there is near the zenith a single star almost capable of matching alone the united beauty of Zodiac and Galaxy, the star Vega, or Alpha Lyræ. It, too, has a pair of attendants, but they are only of the fourth magnitude, and, instead of standing one on either side of their chief, they mark out with it the corners of a little triangle. The coronet of dazzling blue which surrounds Vega in the telescope is extremely beautiful.

Vega is demonstrably a far greater sun than ours—possibly a thousand times greater—and toward that wonder of the star depths the solar system is flying at the rate of at least 800,000 miles a day. If it should turn out that the solar motion is almost directly toward Vega, interesting experiences are doubtless in store for our descendants some hundreds of thousands of years hence. Our so steady seeming earth belongs to a family of incorrigible adventurers, and its changes of scene were by no means exhausted when the poles sweated with tropic heat, or when ice mountains glittered upon New England. More than once science has wondered whether the endless voyaging of the planet may not be concerned with some of these alternations of climate and temperature. Here is food for reflection as one gazes at Vega sparkling in the summer evening air, and remembers how we are speeding to meet, or to pass, it.

THE PLANETS.

Mercury, in Leo, is an evening star rapidly approach-