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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 1028.

For the Week Ending September 14, 1895.

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THE PHYSICS OF THE BICYCLE.

Referring to our article on "The Physics of the Bicycle," contained in the SCIENTIFIC AMERICAN of August 3, 1895, the Boston Journal of Commerce has to say: "It is with extreme reluctance that 'our' expert bicyclist is compelled to dissent from the views of so able and accomplished an authority on physical science as the SCIENTIFIC AMERICAN, as to some of the conclusions arrived at in the above clipping. He has just returned from a three weeks' tour of duty, doing the convolutions of the White Mountains, and the expert practical knowledge of 'biking' which he has gathered in on this as well as several other occasions makes it evident to him that the writer is not much of an expert on the bicycle, or he would have noticed at the very first that there is a constant effort to keep the wheel in an upright position. In just the act of keeping the balance alone, to say nothing about steadying, the wheel has to be turned to the right whenever the rider finds himself falling in this direction, which gradually brings the wheel under the center of gravity, and turned to the left whenever it is found necessary to catch the balance in this direction. An expert has no trouble in jumping on the crank shaft of a single wheel and keeping his balance in all directions, with only one single point beneath him to rest upon, by simply increasing the speed of the wheel whenever he is tipping forward, and slacking up to regain any tendency to fall backward, guiding to either the right or left to keep in an upright position. To stand still on a bicycle the front wheel is turned to an angle of about 45° and pedaled forward and back just enough to preserve the center of gravity."

All this simply substantiates what is said in the article referred to. If the writer had gone a little deeper into the physics of the subject, his comment might have been different.

Why is a "constant effort" necessary to keep the bicycle up? It is because the "additional force" mentioned in our article, such as the movement of the rider, an obstruction, or the wind, acts upon the wheel to change its plane of motion, whereupon the rider must make some effort to maintain his balance, as stated by the "bicycle expert."

No one can take the first lesson in bicycle riding without having it thoroughly impressed on his mind that there "must be a constant effort to keep the wheel in an upright position." But this does not alter the "physical fact." It is still true that "a body in motion persists in maintaining its plane of motion unless some additional force acts on the body at an angle to the original line of motion." The additional forces referred to which tend to upset the bicycle are accidental and very frequent, requiring the almost continuous swinging of the guide wheel in one direction or the other, as stated by the "expert." An expert wheelman can keep upon a straight course without manipulating the guide wheel at all.

A bicycle with the guide wheel fixed, with a load immovably fastened to it, when set in motion on a smooth surface, will retain its upright position so long as its momentum lasts. A common wagon wheel set rolling with considerable speed will roll on alone in a vertical plane until it meets an obstruction or loses its momentum.

There is truth in the "bicycle expert's" remarks, but they do not in the least alter the physical fact as originally stated.

PROCEEDINGS OF THE AMERICAN ASSOCIATION AT SPRINGFIELD, MASS.

Besides furnishing facilities for seeing Forest Park, the Armory and other local attractions, the generosity of the local committee gave the scientific visitors an opportunity to see some of the educational institutions of Western Massachusetts. A special train took 300 of them to Amherst, where they first inspected the State agricultural college, its farm and garden, and particularly its insecticide experiment station, where war is waged on the gypsy moth, the elm beetle and other insect pests. Next the laboratory, observatory, library and cabinet of Amherst College were visited. The famous collection of twenty thousand tracks made ages ago by birds and reptiles was explained familiarly by Professors Hitchcock, Emerson and Cope. These impressions left on the red sandstone were of all sizes, from those that might have been made by mice up to those of elephantine magnitude. The largest were by what was significantly named the Brontozoum giganteum, literally the great thunder beast. The stale jest as to this being the headquarters of the American Track Society was capped by the new one that these tracks were made by a "four-toed toad." Smith College for young women was visited at Northampton, whose fine art gallery, cabinet, and botanical garden were much admired. Trolley rides were taken to Easthampton, Williamsburg, and other points. A party of eighty visited Mount Holyoke College at South Hadley, the pioneer of institutions for the higher education of women, whose new buildings for scientific purposes were examined with a great degree of interest.

Additional value was imparted to these and other neighboring excursions by two evening lectures with lantern illustrations. The first of these was by Prof. W. M. Davis, of Harvard, on the "Geology of the Connecticut Valley." His style is a model of clearness, and he gave to even those of his hearers who were familiar with the main facts a more vivid apprehension of them. The lowlands and highlands, the valleys and mountains, the ridges and sheets of sandstone, the scattered bowlders and beds of gravel were all made tributary to practical lessons concerning not only geology but also geography, agriculture and the progress of civilization. The other lecture was by Dr. Cornelius Van Brunt, of New York, concerning the "Wild Flowers of the Connecticut Valley." He showed rapidly and with running explanations 140 lantern slides which were all taken from nature by himself and painted by Mrs. Van Brunt, and which are certainly some of the most brilliant and beautiful slides ever shown on the screen. He admitted, however, that most of his specimens were from the Hudson River Valley, though none were exhibited that could not be also found in the valley of the Connecticut.

In connection with these illustrated lectures which were given in the City Hall, and were complimentary to the citizens of Springfield, mention may here be made of the day given by the section of physics to the subject of color photography. This was in what is known as Evangelist Hall, a much smaller room, and the hearers were mainly members of the association. The main paper on this fascinating art was by Mr. F. E. Ives, of Philadelphia, whose experiments have been frequently described. Three different methods are now attracting attention. The Lippman, or direct process, is based on the theory that if the light which forms the image passes through the sensitive film to a mirror in contact with it, the reflected rays produce the desired phenomena within the film. In practice a structureless film of bromide of silver in gelatine is used backed by mercury. But out of thousands of exposures few are successful. Hence the public expect better results from the composite methods of Joly or Ives. These rely on the fact that all colors can be reproduced to the eye by mixtures of three spectrum colors—red, green and blue violet. Three negatives are made by exposures through selected color screens adjusted to yield a record of the colors of the object, and a positive made from this set of negatives can at any time be translated in color by lantern projection, or in the photochromoscope. Three images are superimposed on the screen, and the three primary colors are found to be mixed in such proportions as to reproduce every color and gradation of light and shade. In practice the complete color record is now made on a single sensitive plate, at one exposure. Permanent color prints can also be made from the negatives on paper, though by a complicated and costly process detracting from its practical value. Joly, in place of three separate color screens, uses one particolored screen made up of narrow strips of red, blue and green, getting the same result as the Ives process, only by a short cut. Serious practical difficulties are met, and it is liable to yield in the lantern the effect of a colored picture on ribbed paper. All these matters were explained in detail by Mr. Ives, who ended by delighting his audience by the exhibition on the screen of his own admirable and surprisingly beautiful photographic reproduction in natural colors of objects varying in size from a box of candies, or a bouquet, up to the magnificent scenery of the Yellowstone Park. The rich azure of the pools, the fine browns of the ledges, the vivid green of the foliage, and all other tints and shades were brought out with a truthfulness and loveliness surpassing the skill of the painter.

In this same section remarkable facts were given by Professor Van Nardoff, of Barnard College, proving beyond question that red, green and blue are the primary colors, instead of red, blue and yellow, as has long been stated. His delicate apparatus formed white light from the former three as primaries, and also brought out various tints, by ingenious combinations whose mechanical details were devised by Mr. F. W. Huntingdon, of Montclair, N. J.

One of the most interesting papers was on voice production, and another on voice analysis, by Dr. Muckey and Dr. Hallock. These were illustrated, showing the vocal cords in action. The total range of sounds made by human voices is about six octaves. The greatest range of any single voice known was attained by Lucrezia Ajugari, in 1770, who actually sang from G2, with only 192 vibrations per second, up to C6, with 2,048 vibrations—a range of four and a half octaves. Ellen Beach Yaw has lately reached the same upper limit, but it is done by adding a child's register to that of a woman.

Voice analysis is recorded by making a resonator for the fundamental and overtones so as to sound in sympathy, and to cause tiny gas jets to flicker. These variations have hitherto been drawn by hand, but now they are photographed by a swiftly moving camera, so as to make a perfectly accurate record. Practically this invention is very useful in analyzing the voices of singers or speakers, and determining at once where they need improvement.

The address by Vice-President W. LeConte Stevens,