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### THE PHYSICS OF THE BICYCLE.

Bicycle," contained in the SCIENTIFIC AMERICAN of Connecticut Valley." His style is a model of clearness, August 3, 1895, the Boston Journal of Commerce has to and he gave to even those of his hearers who were say: "It is with extreme reluctance that 'our' expert familiar with the main facts a more vivid apprehenbicyclist is compelled to dissent from the views of so sion of them. The lowlands and highlands, the able and accomplished an authority on physical sci-valleys and mountains, the ridges and sheets of sandence as the SCIENTIFIC AMERICAN, as to some of the stone, the scattered bowlders and beds of gravel were conclusions arrived at in the above clipping. He has all made tributary to practical lessons concerning not just returned from a three weeks' tour of duty, doing the only geology but also geography, agriculture and the convolutions of the White Mountains, and the expert progress of civilization. The other lecture was by Dr. practical knowledge of 'biking' which he has gathered Cornelius Van Brunt, of New York, concerning the in on this as well as several other occasions makes it "Wild Flowers of the Connecticut Valley." He showed evident to him that the writer is not much of an ex- rapidly and with running explanations 140 lantern pert on the bicycle, or he would have noticed at the slides which were all taken from nature by himself and very first that there is a constant effort to keep the painted by Mrs. Van Brunt, and which are certainly wheel in an upright position. In just the act of keep- some of the most brilliant and beautiful slides ever ing the balance alone, to say nothing about steadying, shown on the screen. He admitted, however, that the wheel has to be turned to the right whenever the most of his specimens were from the Hudson River rider finds himself falling in this direction, which Valley, though none were exhibited that could not be gradually brings the wheel under the center of gravity, also found in the valley of the Connecticut. and turned to the left whenever it is found necessary | In connection with these illustrated lectures which to catch the balance in this direction. An expert has were given in the City Hall, and were complimentary no trouble in jumping on the crank shaft of a single to the citizens of Springfield, mention may here be wheel and keeping his balance in all directions, with made of the day given by the section of physics to the only one single point beneath him to rest upon, by subject of color photography. This was in what is simply increasing the speed of the wheel whenever he known as Evangelist Hall, a much smaller room, and is tipping forward, and slacking up to regain any ten- the hearers were mainly members of the association. dency to fall backward, guiding to either the right or The main paper on this fascinating art was by Mr. left to keep in an upright position. To stand still on F. E. Ives, of Philadelphia, whose experiments have a bicycle the front wheel is turned to an azgle of about, been frequently described. Three different methods 45° and pedaled forward and back just enough to are now attracting attention. The Lippman, or direct preserve the center of gravity."

ticle referred to. If the writer had gone a little deeper mirror in contact with it, the reflected rays produce into the physics of the subject, his comment might the desired phenomena within the film. In practice a have been different.

stated by the "bicycle expert."

pert 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 with considerable speed will roll on alone in a vertical plane until it meets an obstruction or loses its momentum.

they do not in the least alter the physical fact as originally stated.

## SPRINGFIELD, MASS.

Besides furnishing facilities for seeing Forest Park, surpassing the skill of the painter. the Armory and other local attractions, the generosity In this same section remarkable facts were given by of the local committee gave the scientific visitors an Professor Van Nardoff, of Barnard College, proving opportunity to see some of the educational institutions beyond question that red, green and blue are the of Western Massachusetts. A special train took 300 of primary colors, instead of red, blue and yellow, as them to Amherst, where they first inspected the State 'has long been stated. His delicate apparatus formed agricultural college, its farm and garden, and particularly white light from the former three as primaries, and larly its insecticide experiment station, where war is also brought out various tints, by ingenious combinawaged on the gypsy moth, the elm beetle and other tions whose mechanical details were devised by Mr. insect pests. Next the laboratory, observatory, libra- F. W. Huntingdon, of Montclair, N. J. ry and cabinet of Amherst College were visited. The One of the most interesting papers was on voice profamous collection of twenty thousand tracks made duction, and another on voice analysis, by Dr. ages ago by birds and reptiles was explained familiarly | Muckey and Dr. Hallock. These were illustrated, by Professors Hitchcock, Emerson and Cope. These showing the vocal cords in action. The total range of impressions left on the red sandstone were of all sizes, sounds made by human voices is about six octaves. from those that might have been made by mice up to The greatest range of any single voice known was atthose of elephantine magnitude. The largest were by tained by Lucrezia Ajugari, in 1770, who actually what was significantly named the Brontozoum gigan- sang from G2, with only 192 vibrations per second, up teum, literally the great thunder beast. The stale jest to C6, with 2,048 vibrations—a range of four and a as to this being the headquarters of the American half octaves. Ellen Beach Yaw has lately reached the Track Society was capped by the new one that these same upper limit, but it is done by adding a child's tracks were made by a "four-toed toad." Smith College register to that of a woman. for young women was visited at Northampton, whose Voice analysis is recorded by making a resonator fine art gallery, cabinet, and botanical garden were for the fundamental and overtones so as to sound in much admired. Trollev rides were taken to Easthampsympathy, and to cause tiny gas jets to flicker. ton, Williamsburg, and other points. A party of These variations have hitherto been drawn by hand,  $\circ$  eighty visited Mount Holyoke College at South Hadley, but now they are photographed by a swiftly moving the pioneer of institutions for the higher education of camera, so as to make a perfectly accurate record. women, whose new buildings for scientific purposes Practically this invention is very useful in analyzing were examined with a great degree of interest. the voices of singers or speakers, and determining at Additional value was imparted to these and other once where they need improvement. neighboring excursions by two evening lectures with

lantern illustrations. The first of these was by Prof. Referring to our article on "The Physics of the W. M. Davis, of Harvard, on the "Geology of the

process, is based on the theory that if the light which All this simply substantiates what is said in the ar- forms the image passes through the sensitive film to a structureless film of bromide of silver in gelatine is Why isa "constant effort" necessary to keep the bi- used backed by mercury. But out of thousands of cycle up? It is because the "additional force" men- exposures few are successful. Hence the public extioned in our article, such as the movement of the pect better results from the composite methods of rider, an obstruction, or the wind, acts upon the wheel Joly or Ives. These rely on the fact that all colors can to change its plane of motion, whereupon the rider be reproduced to the eye by mixtures of threespectrum must make some effort to maintain his balance, as colors-red, green and blue violet. Three negatives are made by exposures through selected color screens No one can take the first lesson in bicycle riding adjusted to yield a record of the colors of the object, without having it thoroughly impressed on his mind and a positive made from this set of negatives can at that there "must be a constant effort to keep the any time be translated in color by lantern projection, wheel in an upright position." But this does not alter or in the photochromoscope. Three images are superthe "physical fact." It is still true that "a body in imposed on the screen, and the three primary colors motion persists in maintaining its plane of motion un- are found to be mixed in such proportions as to reless some additional force acts on the body at an an- produce every color and gradation of light and shade. gle to the original line of motion." The additional In practice the complete color record is now made on a forces referred to which tend to upset the bicycle are single sensitive plate, at one exposure. Permanent accidental and very frequent, requiring the almost color prints can also be made from the negatives on continuous swinging of the guide wheel in one direc- paper, though by a complicated and costly process detion or the other, as stated by the "expert." An ex- tracting 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 surface, will retain its upright position so long as its is liable to yield in the lantern the effect of a colored momentum lasts. A common wagon wheel set rolling 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 There is truth in the "bicycle expert's" remarks, but 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 PROCEEDINGS OF THE AMERICAN ASSOCIATION AT vivid green of the foliage, and all other tints and shades were brought out with a truthfulness and loveliness

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