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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, before this section, on "Recent Progress in Optics," showed how rapidly the army of workers in that direction had increased and what wonders they were accomplishing. Any notice of such an exhaustive paper must necessarily be incomplete. The physicist is nearly powerless without the aid of a high order of mechanical skill. This is exemplified by what Brashear has done to help Michelson to measure the waves of light with accuracy so great that no error equal to one-twentieth of a wave length should appear on the reflecting surfaces. This entire work has been distinctly American. Fluorescent solutions enable us to bring within the domain of optics many wave lengths previously invisible. It is proved that the shining of luminous paint is accompanied with chemical action, and renders probable what may be termed chemi-luminescence. The fact that substances which show no light at ordinary temperatures become luminous when warmed warrants the special term thermo-luminescence. On the other hand, many substances grow luminous at the temperature of liquid air (—180° C.) that ordinarily seem incapable of it; e. g., ivory, gelatine and pure water. All luminescence is probably jointly physical and chemical. The problem of securing on the photographic plate a lasting image of the varied tints of the spectrum has at last been fully solved, from a scientific standpoint, even if commercial demands are yet made in vain. This naturally led Prof. Stevens to a review of the experiments by Lippman, Joly and Ives concerning color photography. He also rapidly reviewed the recent applications of the spectroscope, and recent researches in the domain of polarized light. He spoke of progress in physiological optics.

Dr. William McMurtrie's address before Section C was on "The Relation of the Industries to the Advancement of Chemical Science." This was finely illustrated by the history of the development of the coal tar color industry, and other examples of the interplay between the new elements, new compounds, new laws and new methods that are constantly following each other so rapidly that few of us can keep ourselves informed concerning them. The study of the ultimate history of all industries will show that, as they grow, they make increasing demands upon educated men. For this reason the demand is growing for a combination of chemical and engineering knowledge in the same person.

This remark naturally leads us to a word about Prof. William Kent's address on the "Relation of Engineering to Economics." The true definition of engineering is that it is "the art of directing the great sources of power in nature for the use and convenience of man." Political economy is the science of wealth; but engineering is its producer by utilizing the forces of wind, running water, fuel as found in forests, coal mines, natural gas and oil wells. Mr. Kent dwelt particularly on the results accomplished by the use of coal as a vast source of reserved power and energy. After many quotations from the standard authorities, and examples furnished by the existing state of things, he concluded that engineering will contribute more largely than any other cause to merge capital and labor, by making the laborers themselves the capitalists. This will be the crowning triumph of engineering, and will warrant the political economists in burning all their old books and building a superb monument to James Watt, the engineer, who did more than all others to increase the wealth of the nations.

One of the most ancient things men have ever made is the arrow, and, perhaps, no living man has ever made this weapon the subject of such careful and successful study as Frank H. Cushing, the vice-president of the anthropological section. He skillfully traced it back to its simplest beginning, and told its fascinating history down to the present day. He told his own boyish experience in trying to manufacture stone arrows like those of the Indians, his tool being a tooth brush handle tied to a rod with a shoestring. He claims that this success proved that the primitive man first tried to shape an arrow from bone, then found, as he himself did, that the bone would chip away flakes from the flint, and thus discovered that most ancient of all the arts. He also expressed the conviction that the primitive men, judging by his own long residence amid the archaic Zunis, and other aboriginal tribes, must have had many simple, yet ingenious methods of work. They sought the materials amid beds of pebbles or buried ledges, blocking out the blanks for easy transportation as broad, leaf-shaped blades which were hidden in the soil. These caches are found to-day on old Indian ranges. They learned to work rapidly. He testified that in thirty-eight minutes he had actually made seven finished quartz arrow tips. Certain ceremonies were performed after the arrowmakers had done their work, which were described. The shafts were cut with due sacrifices, peeled and seasoned with reference to the uses to which they were to be put, for war or the chase. The feathering was from the wings of eagles or hawks, split, trimmed, and tufted according to special ideas of their own. Mr. Cushing gave details of the methods of the Pueblos, the Peruvians and others, in making not only arrows, but knives, spear heads, harpoons and all the various flint tools and implements. In his opinion, many of these articles were used indifferently for sundry purposes, just as a boy now uses his jack knife in many ways.

The arrow was reverenced by primitive man. The best archer became the born leader. The chosen arrow was the chieftain's sign. A bundle of these weapons was the most costly offering to the gods. Thus it won its place, not only in war and the chase, but in worship and ceremony. So it was amid the Romans, the Babylonians and the Chinese, as well as amid the early races of this country. Incidents were told showing its use in prayer, sacrifice and divination, and its relation to records, writings, gambling, and astrology. Thus what was at first but a flint taken from the ground became a symbol and a message for revealing the most secret thoughts of the human soul and a plumed stylus shaping the history of mankind.

Before the same section Miss Alice C. Fletcher read a paper on "Indian Songs and Music," giving the results of long study among the native tribes of our country. She reminded her hearers that every Indian ceremony had its appropriate music, and that among the aborigines, as well as among civilized nations, the songs of any people express their emotional life. Instead of being always improvised, as is commonly supposed, many Indian songs have been handed down from former generations. Yet a good new song rapidly wins popularity, and travels from tribe to tribe. The difficulties were related that had attended her efforts to collect Indian songs. Sacred songs and love songs were the most hard to gather. Persons may live a long while among the Indians and never hear them. In recording their songs the graphophone has been helpful, where it was available. The rhythm is always marked, usually with motions of the body. But there is also a material sense shown by singing in unison. Miss Fletcher has studied hundreds of Indian songs and those of widely scattered tribes, comparing them with the folk song of other races, with the result that they are universally built along the tones of a chord. Even when they sound like wild shouting this is found to be the case. The harmonic sense guides the voice when set going by the rhythmic impulse. In each song occurs a short melodic phrase, and these phrases are correlated into clauses.

Professor F. W. Putnam, whose long continued labors in archæology entitle him to speak with authority, described symbolic carvings on the ancient mounds of Ohio. His conviction is that the mound builders were a branch of the great southwest people who were represented by the ancient Mexicans, who reared the cities of Yucatan, and that these symbols closely resemble carvings found in Central America. Dr. Haliburton followed with remarks on the year of the Pleiades in prehistoric star lore; claiming that all over the world are vestiges of a calendar regulated by that group. He cited the Greeks, Romans, Pueblos, Polynesians, Blackfeet Indians, etc., and was fully confirmed in his remarkable statements by Professor Peet, Mr. Cushing, and other members present.

Professor G. F. Wright brought what he claimed to be an additional relic of prehistoric man in America, in the shape of a rough bit of stone from the glacial gravel near Steubenville, Ohio, which excited considerable discussion. By some it was regarded as a true glacial implement, while others doubted. The general feeling seemed to favor his claim.

At a joint meeting of several sections, Professor W. L. Moore, the chief of the weather bureau, spoke on its relations to the science and industry of the country. As a single instance he cited the fact that $36,000,000 had been saved to our shipping by the prediction of one great Atlantic storm last year. He marked out the new fields of inquiry that the bureau ought to enter, especially amid the upper strata of the air, and the study of the soil as well as the air in forecasting frosts. He traced the development of the weather bureau from the time when it only gave out "probabilities" down to the present accurate forecasting by States.

The nine sections met in different buildings, some of them far apart, and it was out of the question to keep track of all the papers one wanted to hear. Many of those not now mentioned were no doubt of equal value with those reported. It was worthy of note that many of the sections gave prominence to educational features of their special work. Giving a summary of the work done: there were 42 papers read in the section of Chemistry; 34 in that of Physics; 33 in that of Anthropology; 28 in that of Botany; 19 in that of Geology and Geography; 16 each in the sections of Astronomy and of Zoology; 13 in that of Economics and Statistics—or, as it is henceforth to be styled, "Social and Economic Science," and 6 in that of Mechanical Science and Engineering. This makes a grand total of 207 papers actually read in the nine sections, not counting the large number read in the affiliated societies meeting before and after the parent organization. Besides these there were three public addresses by Professor Davis, Dr. Van Brunt and Professor Bickmore, each illustrated, one presidential and seven vice-presidential addresses. On Sunday, though there were no business meetings, most of the pulpits of Springfield were occupied by clerical members of the A. A. A. S. among whom may be mentioned Professor G. F. Wright, of Oberlin; Professor W. N. Rice, of Wesleyan University; President Woodrow, of South Carolina; Dr. H. C. Hovey, of Newburyport. Religious addresses were also made by Major Jed Hotchkiss, of Staunton, Va.; Miss Alice C. Fletcher, of Cambridge, and several others.

There were in attendance 367 members and fellows, hailing from thirty States and from Canada. The ranks have been thinned this year by the death of 42 members and fellows, and increased by the election of 185 new members; while 58 old members have been promoted to be fellows, and two persons were made honorary fellows.

An important step was taken in instructing the president and permanent secretary to arrange with the University of Cincinnati for safely storing the vast mass of volumes and scientific papers that have accumulated at the Salem office.

Buffalo was chosen as the next place of meeting, where the association has been in the habit of meeting every ten years. It was decided to meet in the fourth week of August, 1896, and to begin on Monday instead of on Thursday, although this change was not made without considerable opposition.

The following officers were chosen for the ensuing year, viz.:

President—Edward D. Cope, of Philadelphia.

Vice-Presidents—A. Mathematics and Astronomy, William E. Story, of Worcester, Mass.; B. Physics, Carl Leo Mees, of Terre Haute, Ind.; C. Chemistry, W. A. Noyes, of Terre Haute, Ind.; D. Mechanical Science and Engineering, Frank O. Marvin, of Lawrence, Kan.; E. Geology and Geography, Benjamin K. Emerson, of Amherst, Mass.; F. Zoology, Theodore N. Gill, of Washington, D. C.; G. Botany, N. L. Britton, of New York City; H. Anthropology, Alice C. Fletcher, of Washington, D. C.; I. Social Science, William R. Lazenby, of Columbus, O.

Permanent Secretary—F. W. Putnam, Cambridge, Mass.

The Moon's Power over the Weather.

Fallacies about the moon are numerous, such as that the full moon clears away the clouds; that you should only sow beans or cut down trees in the wane of the moon; that it is a bad sign if she changes on a Saturday or Sunday; that two full moons in a month will cause a flood; that to see the old moon in the arms of the new brings on rain, and many others, of which a catalogue alone would take up a good deal of space. M. Flammarion says that "the moon's influence on the weather is negligible. The heat reaching us from the moon would only affect our temperature by twelve millionths of a degree; and the atmospheric tides caused by the moon would only affect the barometric pressure a few hundredths of an inch—a quantity far less than the changes which are always taking place from other causes." On the whole we are disposed to agree with the rhyme which thus sums up the subject:

The moon and the weather
May change together;
But change of the moon
Does not change the weather.

Even the halo round the moon has been discredited, for Mr. Lowe found that it was as often followed by fine weather as by rain, and Messrs. Marriott and Abercromby found that the lunar halo immediately preceded rain in thirty-four cases out of sixty-one. We always have a lingering hope that some future meteorologist will disentangle the overlapping influences, and arrive some day at a definite proof that our satellite after all has something to do with our weather.—Nature.

How to Succeed as a Chemist.

"I noticed," said the druggist to his assistant, "that a gentleman came in with a prescription, and that you took it and gave him the stuff in about three minutes. What do you mean by that?" "It was only a little carbolic acid and water," replied the assistant. "I simply had to pour a few drachms of acid into the bottle and fill it up with water." "Never mind if you had only to do that," the druggist declared. "Don't you know that every prescription must take at least half an hour to fill or the customer will think he isn't getting anything for his money? When a prescription for salt and water, or peppermint and cough sirup is handed to you, you must look at it doubtfully, as if it were very hard to make up. Then you must bring it to me, and we will both read it and shake our heads. After that you go back to the client and ask him if he wants it to-day. When he says he does, you answer that you'll make a special effort. Now a patient appreciates a prescription like that he's had so much trouble over, and when he takes it he derives some benefit from it. But don't you do any more of that three-minute prescription business, my boy, if you want to become a first-class druggist."—Sheffield Telegraph.