Correspondence.

Chain and Sprocket Problem.

To the Editor of the SCIENTIFIC AMERICAN:

As the theory of the movement of a bicycle is being gradually introduced into text books on mechanics and discussed in mathematical journals, it is interesting to know whether certain results of mathematical investigation in this direction might be of practical value to the constructor. In this communication no reference shall be made to the dynamical laws governing the motion of a bicycle, but I shall submit for practical consideration the arithmetical solution of a problem which is connected with the sprockets and chain of a bicycle, and which may be stated as follows:

What must be the relation between the number of teeth of the sprockets and the number of links of the chain in order to have a continuous change between the teeth of the sprockets and the links of the chain?

To make the problem clear, consider a tooth A_m of the front sprocket and a tooth B_n of the rear sprocket which are connected with the links a_m and b_n of the chain respectively (m and n designate the orders of the teeth in counting). In a similar manner let A_{m-1}, B_{n-1}, a_{m-1}, b_{n-1} be the teeth and links next to the previous teeth and links in the opposite direction of the motion of the teeth and links. Now let the chain describe a complete revolution. What must be the relation between the number of teeth and links, so that after a complete revolution of the chain the links a_{m-1} and b_{n-1} will be applied to the teeth A_m and B_n respectively? To answer this question let m and n be the number of teeth of the rear and front sprocket respectively, and c the number of links of the chain.

If c is divisible by m and n the problem cannot be solved, since the same link will always be applied to the same tooth. The conditions of the problem are evidently

$$(1)\quad ma + 1 = c$$
$$(2)\quad nb + 1 = c$$

where a and b are two integral numbers to be determined. The co-existence of these conditions gives the required relation—

$$(3)\quad ma = nb, \text{ or } \frac{n}{m} = \frac{a}{b}$$

i. e., the two integral numbers a and b must be proportional to the numbers m and n respectively. As an example, suppose that the front sprocket has 27 and the rear sprocket 9 teeth. Then $\frac{27}{9} = \frac{b}{a} = \frac{6}{2}$, assuming $a = 2$ and $b = 6$, the number of links, according to (1) and (2),

$$c = 27 \,.\, 2 + 1 = 9 \,.\, 6 + 1 = 55.$$

In this case the gear would be (28-inch wheel)

$$\frac{27}{9} \,.\, 28 = 84.$$

During a complete revolution of the chain the front sprocket makes $2\frac{1}{7}$ revolutions and the rear sprocket $6\frac{1}{9}$ revolutions, so that during the second and every successive revolution of the chain every link is applied to a tooth next to the tooth in the previous revolution. A great number of other possibilities and extensions of the original problem might be added, but the foregoing example is sufficient to illustrate its value. The condition implied by equations (1) and (2) is seldom realized in the driving mechanism of a bicycle. Take, for instance, the data of a real case, where $m = 24$, $n = g$ and $C = 56$. It is impossible to find two numbers a and b, so that

$$24 \,.\, a + 1 = 56, \text{ and } 9 \,.\, b + 1 = 56.$$

The practical advantage of the arrangement of the number of teeth and links, according to the condition named above, seems to lie in the fact that by constant interchanging of teeth and links driving the motion the movement and wearing of sprockets and chain becomes more uniform. It would be interesting to know what practical bicycle builders think of such an improvement, and how much importance they attach to my proposition.

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Kansas State Agricultural College, June 6, 1899.

A Hydrogen Experiment.

To the Editor of the SCIENTIFIC AMERICAN:

In Storer and Lindsay's Elementary Manual of Chemistry, page 43, we find the following experiment:

"Support a rather wide tube of thin glass—the neck of a broken retort, for example—in a vertical position, and connect the upper opening with a gas holder containing hydrogen. Allow the gas to flow until the tube is filled; then apply a lighted match to the mouth of the tube, and regulate the flow of gas so that the latter may continue to burn slowly at the lower edge of the tube.

"With a second gas holder containing oxygen, connect a piece of narrow gas tubing drawn out to a fine point; and, while the oxygen is flowing through this tube, pass it up into the larger tube filled with hydrogen. As the stream of oxygen passes through the burning hydrogen at the bottom of the vertical tube, it takes fire, and afterward continues to burn in the atmosphere of hydrogen within the tube. Care must be taken that no mixture of hydrogen and oxygen shall accidentally accumulate in the tube."

The members of my chemistry class decided to put this matter to a test and determine, if possible, whether it was the oxygen burning in the atmosphere of hydrogen, or whether it was the hydrogen that was really burning while the oxygen supported the combustion. At first a glass tubing was used to convey the oxygen gas into the atmosphere of hydrogen, which appeared precisely as though the oxygen were burning and gave a very yellow flame, due, of course, to the sodium in the glass. Next a platinum tube was substituted for the glass tube and the operation repeated in a darkened room, when a dark zone could be readily distinguished in the center of the flame, surrounded by the typical blue, almost invisible hydrogen flame, which we think proves conclusively that the hydrogen burns around the outside of the escaping oxygen, and that the oxygen furnishes or supports the combustion, and that the oxygen itself does not burn.

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[It is usual to call hydrogen a combustible and oxygen a supporter of combustion; but the usage is a convenience simply. Both are consumed in combustion. Neither of these could be set on fire in a gas with which it would not combine. The language of the experiment quoted is much abler than the text book from which our correspondent quotes it. We do not consider the point involved of much practical consequence. —ED.]

He Welcomes the Trusts.

A correspondent of The Age of Steel writes: Among my valued acquaintances here in the East is a gentleman who has the distinction of being a much-sought and reliable public accountant. He is, in fact, one of the most expert in the profession. I met him the other day rushing down Broadway to catch a train. "Busy! Well, I should say so," said he in reply to my salutation. "Run to death by trusts; can't begin to keep up with calls; wish there were fourteen days in each week. Why? I get paid $25 to $50 per day to go through the books of concerns going into trusts, because the trusts won't buy a concern on its own representation of its condition, and I am called in. My charges don't cut any ice in the matter at all; it is a correct statement they want.

"And this isn't the best part of it either, for the capitalization of these trusts represents fully 50 per cent of water. The absolute cash value, shown by my reports, is usually covered by the preferred, guaranteed, dividend-paying bonds, and these bonds are taken by those inside the trusts, and the stock, which is usually all water, is sold to the dear public. Now, it won't take long for the public to get its eye teeth cut, and to wake up to the fact that they have tackled the wrong end of the mule, and that they need not even hope for dividends. Then there will be some high and lofty kicking and an accounting will be demanded, and then I will be again called in. Oh, I tell you these trusts are a great thing, and I catch them both coming and going. But let me tell you something, my dear boy, sub rosa, you know—don't buy any stock in a trust."

Meeting of the Association of Agricultural Chemists.

The Sixteenth Annual Meeting of the Association of Official Agricultural Chemists will be held in San Francisco, Cal., beginning July 5. Arrangements have been perfected by which members will receive substantial reduction on the railroads and at hotels, and interesting excursions have been planned. The agricultural industries of California are of such enormous importance that probably no other locality could be selected which would answer better as a place of meeting. Dr. H. W. Wiley, Chief Chemist of the United States Department of Agriculture, is the Secretary of the Association of Official Agricultural Chemists.

Removal of the Reservoir.

The actual work of tearing down the old reservoir for the New York Library, on Fifth Avenue, between 40th and 42d Streets, was begun on June 7. The debris in the interior of the reservoir, which has not been used for some time, will be first removed, and the destruction of the walls will soon begin. There are 110,000 cubic yards of stone work to be removed. The contractor will receive $105,000 for the removal of the stonework, and the remainder of the $378,000 which the contractor is to receive will be for the construction of the foundation for the new Library.

AN Automobile Show will be opened on June 17, at Richmond, near London, by Prince Edward of Saxe-Weimar. There will be tests of hill climbing and races between fast trotting horses and automobiles. An American company is about to establish a motor carriage factory at Coventry. It is possible that an automobile race will be held between New York and Chicago, between M. Charron, the winner of the French automobile race, and the inventor of the Winton machine.

Science Notes.

A Cincinnati physician has been making practical tests in cigar factories on the eye of the employes. The test is to discover the effect upon the eyes of persons addicted to excessive smoking, also to see what effect the fumes of tobacco in factories have on the sight. He also intends to examine the eyes of letter carriers and others with reference to the effect of smoking on the eyes.

The Sydney, Australia, cycle track has been lighted in a novel way, by means of inverted arc lights. Fifty-five arc lights and seventy incandescents are placed around the track at intervals of thirty-five feet, the lamps being inverted with the reflectors immediately over the arc. There are absolutely no shadows cast, and leading cyclists are of the opinion that it is safer to ride at night under this light than by daylight.

A curious event recently occurred in Oklahoma. The village of Mountain View, Oklahoma, was organized in a day. A rival town existed about a mile and a half west, and it was deemed advisable to consolidate it with Mountain View. The rival, "Oakdale," was purchased entire, for $34,380, and is now being transported to Mountain View. This is probably the first instance where one town was bought out and moved en masse.

In 1854 the "New World" of the People's Line made a record for the run between New York and Albany which has never been equaled, the time being six hours and twenty minutes. The "Adirondack" recently made the trip in six hours and forty-four minutes. The first Hudson River steamer, Fulton's "Clermont," required thirty-two hours to make the run from New York to Albany in 1807. In 1817 the "Chancellor Livingston" made the run in eighteen hours. In 1837 the "Rochester" made a record of ten hours and one minute. In 1860 the "Drew" made the trip in six hours and fifty minutes.

Prof. Moritz has investigated the conditions necessary for the absorption of drugs, and finds that medicaments are absorbed most speedily when taken with plain water while fasting. Soup, milk, wine, etc., retard absorption, even when the medicine is taken fasting, but absorption is still more slow when the medicament is taken with liquid after food, and most slowly of all when taken after food in the absence of liquid. To secure the most speedy absorption of any drug, therefore, it should be administered with water on an empty stomach, and in many cases it will be found that a definite effect will thus be produced, though no effect would be perceptible if the same dose were administered shortly after food.—Münch med. Woch., 45, 1521.

Of late years much attention has been paid to the subject of color blindness among railway employes, but acuteness of hearing has not been equally well observed. The New York Medical Journal quotes Dr. Stein, who has examined forty-four firemen and thirty-eight engine drivers, and finds only three out of the whole number to possess perfectly normal hearing power. He finds, however, by frequent excursions on locomotives that these employes hear sound signals under favorable circumstances, except those of the whistle. Nevertheless, he thinks there should be an established or minimum standard of requirements as to hearing. These views are the result of Continental experiments, and it would be interesting to know what the figures would be as regards the hearing of railway employes in the United States.

"That there is something more serious than the mere wound in the bite even of a healthy animal," says Appleton's Popular Science Monthly, January, "is attested by Mr. Pagin Thornton. . . . 'And what is more surprising to me,' he says, 'is that some of us may have hands crippled for some time from bites of a man's teeth.' Dog bites are always dangerous, but largely from the size of the wound which a dog biting in earnest will inflict. With men they usually fail to do their best. Animals recover from wounds more easily than men do; but Lord Ebrington says that deer bitten by dogs in Exmoor hardly ever recover. Much of the poisoning caused by bites is supposed to be due to the state of the animal's teeth; and in this way the bite of a herbivorous animal, whose teeth are usually soiled, may cause worse after-effects than that of a carnivora, whose wet mouth and wet tongue keep its teeth fairly clean. A similar difference is observable in the effects of being clawed and bitten by carnivora. Wounds made by the claws of leopards are poisonous, while those caused by the teeth are rarely septic. The force with which a bite in earnest is inflicted is an important element in its dangerous character. 'It seems,' says The London Spectator, 'as if for the moment the animal threw all its force into the combination of muscular action which we call a "bite." In most cases the mere shock of impact, as the beast hurls itself on its enemy, is entirely demoralizing, or inflicts physical injury. A muzzled mastiff will hurl a man to the ground in the effort to fasten its teeth in his throat or shoulder. Then the driving and crushing force of the jaw muscles is astonishing.'"