Correspondence.

Speed in Cycling.

To the Editor of the SCIENTIFIC AMERICAN:

Here is a simple means for the bicycle rider to determine at what rate of speed he is riding:

Count the number of complete revolutions made by the crank in eighteen seconds; multiply this by the gear and divide by one hundred; the result is miles per hour. This calculation may readily be done in the head while riding.

I derived this rule as follows:

Let a be the gear of the wheel, then πa equals the distance in inches traveled in one revolution of the crank.

Let s be the number of seconds (to be determined) and r the number of revolutions made by the crank in s seconds. Then

$$\frac{\pi ar}{12} = \text{number of feet traveled in } s \text{ seconds.}$$

Hence

$$\frac{\pi ar}{12 \times 5280} \times \frac{3600}{s} = \text{miles per hour,}$$

which reduces to

$$\frac{0{\cdot}18\ ar}{s} = \frac{18\ ar}{100\ s}$$

Now, by making $s = 18$ seconds, we have rate of speed in miles per hour equal

$$\frac{ar}{100}$$

Believing that I have arrived at something of interest to your readers, I submit it to you for publication in your valuable paper. H. DONALD TIEMANN.

Extinguishing Fires in Bunkers.

City of Plainfield, N. J., Office of T. O. Doane, Chief Engineer of the Fire Department.

To the Editor of the SCIENTIFIC AMERICAN:

I have noticed lately that a great many fires occur in the coal bunkers of our battleships. I suppose that all firemen know how to put out fires in coal heaps. And I think the same scheme applied to coal bunkers would give good results. When a stream of water is turned on a burning coal heap, the ash forms a coating and sheds the water and causes the fire to work down in the pile. I have tried the experiment here of taking a two-inch pipe, beating one end together, perforating the pipe about 5 or 6 feet from the end, with ¼-inch holes, soldering a male hose coupling on the other end. Force the pipe down in the coal heap (the nearer the bottom, the better), connect a line of hose to coupling, turn on stream. The water, as soon as it strikes the hot coal in center of heap, forms into steam, the steam penetrates all parts of coal, and in a very few moments all traces of fire disappear. It seems to me that this scheme could be used on all coal bunkers or any class of vessels, as by this means you get at the bane of the fire, which (from all accounts) seems to originate at the bottom of the bunkers. I have been a constant reader of your paper for thirty years and consider it the best paper I know of for a fireman, and take the liberty of writing to you.

T. O. DOANE, Chief.

August 13, 1898.

SOME OF THE PROPERTIES OF ACETYLENE GAS.

For the sake of the brilliant white light given by this gas we are willing to overlook many dangers and inconveniences, and yet this is no reason why such disadvantages should not be reduced to a minimum. The makers of carbide have endeavored to make a pure carbide, and have succeeded quite well in keeping the sulphur and phosphorus down to a perfectly satisfactory percentage. Makers of generators have tried to turn out an apparatus that will not leak or explode on its own account, and they have succeeded reasonably well. The users of carbide and generators have gone ahead as best they knew how, and have been gaining abundant experience, some of which has been costly, and from which the makers have profited, so that the last year has seen many changes in generator design. Following the history of all new things, the difficulty in introducing this light has been great, and acetylene was, and is now, considered dangerous until proved innocent—just the reverse of legal custom. The trouble does not lie with the gas entirely; the first companies organized did not conduct their affairs in a business-like manner, and all the original companies in this country have failed. In the same way imperfect generators were hurriedly put upon the market and were thrown back on the hands of the manufacturers, the latter in turn being thrown out of the business. It cannot be said that the present forms are perfect either in design or operation, but they certainly are more practicable than the earlier forms.

Upon this subject any new information is always interesting, and it was with considerable pleasure that we received a paper read at Paris by the French engineer Bouvier, in which he discusses some acetylene accidents and incidentally gives considerable data. To those of our readers who are interested in acetylene this will no doubt be instructive, so that we have translated parts of it in the following abstract. He first touches briefly upon the properties of carbide and acetylene.

One pound of carbide of calcium, CaC_2, gives off, under the action of 0·56 pound of water, 5·45 cubic feet of acetylene, C_2H_2, at freezing point and sea level pressure. Good commercial carbides produce, in France, from 4·5 to 4·8 cubic feet of acetylene per pound of carbide, and the gas contains less than 2 per cent of impurities. The specific gravity of carbide is 2·22. The gas is 0·91 of the weight of an equal volume of air, one pound occupies a space of 13·75 cubic feet, or one cubic foot weighs 0·0727 pound; it is the richest of the gaseous carbides, containing about 92·3 per cent of carbon and 7·7 per cent of hydrogen. Its lighting power is equal to fourteen or fifteen times that of gas in French towns, where a 5-foot burner gives but about 16 candles of illumination; its calorific power is 397 calories per cubic foot, or more than double that of French coal gas. The best luminous effects are attained in burners using a gas pressure of 1·18 to 1·57 inches of water. Three inches are preferred in America.

According to recent tests made by Weber, in Switzerland, a Bray 0000 burner when new gave 43·3 candles, with a consumption of 0·95 cubic foot per hour with a pressure of 1·26 inches, but it choked up after twenty hours in service. The same author states that Dr. Billwiller's burner, having two jets striking each other at 90° and drawing along air by a special arrangement, was burned many times by reason of the great excess of air, and with a pressure of 1·9 inches of water gave 29·7 candles while consuming 0·78 cubic foot of gas per hour. Atmospheric burners give best results.

Acetylene ignites at 896° Fah. and is decomposed at 1,436° Fah. Its flame is a succession of explosions taking place so rapidly among the molecules as to appear continuous. Calculation gives a flame temperature of over 4,500° Fah. (4,388° Bunte). Actually it is not as hot as the Bunsen flame of a Welsbach burner, being but about 1,652° Fah. as against that of the latter of 2,550° Fah. Complete combustion requires five volumes of oxygen for every two volumes of acetylene.

At Monnaie, in Germany, during the summer of 1897, an acetylene Bunsen burner was tested whereby a temperature was rapidly obtained of over 2,700° Fah., enabling them to melt a quantity of nickel in thirty minutes which previously required eighty to eighty-five minutes.

The flame is white, of magnificent brilliance, comparable spectroscopically to sunlight, and very well adapted to the comparison of colors and for photographic use, as it is strongly actinic. An acetylene burner produced but half the quantity of CO_2 resulting by burning a Welsbach lamp and but one-fourth of that of a petroleum lamp.

The mixture of acetylene with air is explosive between wide limits: From 5 to 65 per cent of gas, according to Le Chatelier; from 3 to 72 per cent, according to Bunte, also up to 80 per cent; compare this with the range of 8 to 30 per cent with city gas. According to Gréhant, a mixture of one volume of acetylene with nine volumes of air is the mixture giving a maximum explosion.

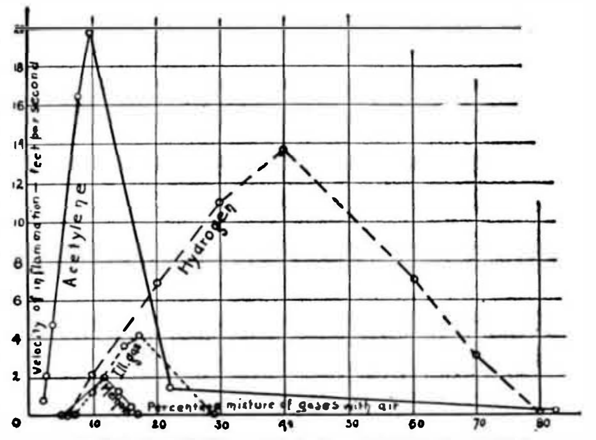
While acetylene alone at atmospheric pressure decomposes at 1,380° Fah., a mixture containing 35 per cent of air, or 65 per cent of acetylene at most, decomposes at 896° Fah., according to Le Chatelier. The velocity with which the ignition travels is very great.

The energy of acetylene is increased by compression (probably due to an increase of latent heat?) which increases the velocity of propagation of combustion and lowers the ignition temperature. Berthelot observed that compressed acetylene was explosive in a tube 0·78 inch diameter and 13 feet long. "At over two atmospheres," he says, "acetylene manifests the ordinary properties of explosives." In some experiments made by the Pintsch Gas Company, of Berlin, a reservoir containing acetylene under six atmospheres' pressure was connected to an iron tube 0·19 inch diameter and 7·8 feet long; at about 5 feet from the receiver the pipe was heated by burning gas and the receiver exploded.

After describing twenty-eight accidents, with not sufficient detail, however, to be interesting, except that they occurred within the past two years and resulted in nineteen deaths, the author proceeds to discuss the reason why acetylene is dangerous, citing a case reported by Pictet and described by Berthelot as follows: "There takes place, without doubt, in the reaction of water upon carbide, local elevations of temperature which are sufficient to carry points of the mass to incandescence; the ignition of these points is sufficient to cause an explosion to propagate through the mass of the gas when compressed." This refers to generators which compress the gas by confining it during generation. An accident of this kind occurred at Baviere, where a workman suddenly let a quantity of water upon a large charge of carbide, then raised the gas holder, letting in some air; generation was taking place and the temperature had evidently reached 896° Fah., for the gas exploded from no outside cause, and amputated both arms of the workman. A number of similar instances have occurred. After-generation, when confined by closing valves, may also explode the generating chamber, by the excess of pressure created when there is sufficient gas and water present, pressure having no effect upon the ability of carbide to give off gas. We may mention here an experiment which is of some interest: It was endeavored to make a table lamp on the principle of dipping carbide into water; the carbide was packed into a cylindrical recipient quite solidly, and was lowered gradually into the water; after a short time the gas was observed to have an ether odor, and on examination the carbide was found red hot, but as there was no air present there was no ignition nor explosion. High temperatures convert acetylene into its polymers, such as benzine, ethers, etc.

Non-compressed acetylene indicates a pressure below two atmospheres in France or 1·5 atmospheres in England. Above these limits it is dangerous, for it ignites at 896° Fah., while other inflammable gases require 1,112° Fah. This limit lowers as the pressure increases, and thus it is that acetylene has been ignited by the heat of a soldering iron. Würzler and Beauregard found that the heat produced by an alcohol lamp was sufficient to provoke decomposition of this gas.

According to Berthelot and Vieille, the velocity of explosion is from 13 to 26 feet per second with mixtures of air containing 5 to 15 per cent of gas. This velocity increases with the pressure under constant volume; the effect of this velocity is to make the explosions very destructive in breaking rather than throwing about. Bunte has made some comparisons between the velocity of the explosive waves for various air mixtures with various gases, and as it is to the point we present it, reduced from the metric to the English system of units:



COMPARATIVE EXPLOSIBILITY OF SOME HYDROCARBON GASES.

The quicker combustion takes place, the more violent the explosion. It will be seen that not only does acetylene have a wide range of explosive mixtures, but that it also is intensely energetic and attains a higher velocity even than hydrogen, and that is why an acetylene Bunsen gives higher temperatures than an oxy-hydrogen flame.

The distinguished specialist, Roussy de Sales, describes an experience with the use of acetylene in a four horse power gas motor where the head of the motor was blown out. The firm of Hille, in Dresden, build acetylene motors. Should the exit orifice of a liquefied or compressed gas cylinder ignite after mixing the gas with air, two explosions, differing in their nature, may follow, the one of the air and gas mixture outside, which may generate 297 calories per cubic foot of acetylene burned; the other the decomposition of the confined pure gas, which gives up its heat of formation, 818 calories per pound, or 452 calories per cubic foot; in other words, two explosions may result, the one caused by a leak forming an air-gas explosive mixture outside, which ignites the leak, raises the temperature of the receiver to the decomposing point of the contained acetylene. Berthelot insists upon the importance of avoiding the frictional heat caused by gas under pressure issuing from their orifices, of static electric sparks, and the spark caused by a substance striking steel.

A cubic foot of acetone under ten atmospheres pressure dissolves 22 pounds or 300 cubic feet of acetylene, sufficient to supply the same burner during twelve hours. When P is expressed in kilogrammes, the number of grammes of acetylene dissolved by the acetone will be expressed, according to Berthelot, by 35 P. According to F. Dommer, under twelve atmospheres acetone dissolves two hundred times its first volume of acetylene gas, a quantity sufficient to feed the previously mentioned burner for eight hours. A cubic foot of carbide, we have seen, will produce enough gas to feed the burner for twenty-four hours.

THE Glacier du Casset, near Briançon, is now regularly operated as an ice quarry, the blocks being cut and conveyed over an overhead cableway to a convenient place for shipment by rail to Paris, there to be consumed in the cafés and hotels of the metropolis.