CURIOUS FACTS ABOUT NUMBERS.

To the Editor of the SCIENTIFIC AMERICAN:

In an article which appeared in the SCIENTIFIC AMERICAN of October 31, p. 299, under the heading "Curious Facts About Numbers," it is stated by Mr. Frank Newcomb that "any number (or all numbers) can be expressed by the difference between two squares." The statement is not true. None of the numbers of the form $4n + 2$ (that is, of the series 2, 6, 10, 14 . . .) can be expressed as the difference between two squares.

One of the most curious facts about numbers seems now to be the following: Any even number (or all even numbers) above 4 (that is, all the numbers 6, 8, 10, . . .) can be expressed as the sum of two prime numbers, as $8 = 3 + 5$, $12 = 5 + 7$, ...

DR. G. VACCA.

Genoa, Italy, November 14, 1908.

GUN EROSION.

To the Editor of the SCIENTIFIC AMERICAN:

In looking over the SCIENTIFIC AMERICAN of 1907, I saw a short article in the August 17 number in answer to Henry B. Griffe's suggestion that to prevent erosion, the charge should be ignited at the base of the projectile. He states that the needle gun did so ignite the charge, and that the recoil was so severe that it was speedily condemned. I think that history will inform him that the reason why it was discontinued was that the gases fouled the mechanism in passing the needle. I have been testing that plan of igniting at base of bullet in bottle-necked shells, and if there is any difference in recoil, it is in favor of igniting at the base of projectile, as it does not have to force any of the powder charge through the reduced hole in the shell. I tapped a small brass tube in the base of shell, and carried it forward to a point close to base of bullet, and with black powder it does not blow off the shell at the neck, as it does not have to force a large part of the powder unburned through the much smaller hole. I notice that there is considerable said about erosion in large ordnance, and difference of opinion as to the cause. It is said that the greater part of the erosion takes place in the first third of the length of bore. I would suggest that the damage to the rifling is done by *abrasion* instead of erosion. The mighty force it takes to suddenly rotate a 1,000-pound shell must cause a terrible rubbing on the edges of the rifling, by the gas check that causes the projectile to rotate, and the friction is much greater during the first third of distance in bore. I do not know whether a gain twist is used in large ordnance or not, but I think that if it is not used, it would be good policy to increase the twist in the rifling, so that as it leaves the muzzle it will have the requisite twist.

JAMES C. WATSON.

Penn Yan, N. Y., November 12, 1908.

The Political Economy of Good Roads.

Poor roads impose an unnecessary financial burden, not only upon those who most constantly use them, but upon the men and women who consume the products grown in the rural sections and brought to cities and towns by farmers.

No study can be more convincing than that of the economic waste placed upon the shoulders of the 85,000,000 people of this land from the almost criminally shameful condition of 2,000,000 miles of road. Every pound of farm products brought from rural sections to thickly-populated centers has placed upon it a fictitious value, because it costs the farmer more to transport it than it would cost him were the roads in passable condition. The price of the lamb chop that Brooklyn eats for breakfast is based, not upon the real value of the lamb, but upon the cost of bringing that lamb from the western fields to the Brooklyn breakfast table. The cost of the breakfast roll would be trifling did it not cost the farmer who grew the wheat from which the roll was made 1.8 cents a bushel more to draw that wheat from his farm nine miles to a railroad station than it cost to carry a bushel of wheat from New York to Liverpool, a distance of 3,100 miles. The cost of a soft-boiled egg, which is also closely related to the American breakfast, is established by the cost of transporting the product of the hen to the hotel, and not because the egg was at all intrinsically worth what was charged for it.

Everybody who thinks must concede the evident fact that if a farmer with two horses can draw but 600 pounds to market in five hours, he would save money if with one horse he could haul 1,200 pounds in two hours. Were the roads in good condition, he could do that and more. Any saving in hauling a ton of farm product would bring a benefit, not alone to the farmer, but to the consumer, and if the product hauled each year was large, it is not hard to figure that the saving would be large. Figures have been assembled to prove that owing to the frightful condition of almost all American roads, it costs 25 cents a ton a mile to haul. The superb roads of the old countries of Europe make possible the hauling of farm products at 12 cents a ton a mile. Therefore, every ton hauled costs the American farmer 13 cents more per mile than the farmers of the old country are forced to pay. The average length of haul of farm products in the United States is 9.4 miles; therefore, were our roads as good as those of France, the farmer's gain would be 9.4 times 13 cents, or approximately $1.23.

Let us see what that amounts to in a year in hauling but a portion of the products which traverse the country roads in wagons. The U. S. Department of Agriculture, through its Office of Public Roads, has collected the figures, and they may be accepted as approximately accurate. During the crop year of 1905-6, 85,487,000,000 pounds of farm products, consisting of barley, corn, cotton, flaxseed, hemp, hops, oats, beans, rice, tobacco, wheat, and wool, were hauled from the places where they originated to shipping points. This vast weight did not, by any means, include all of the crops produced, the most notable exceptions being truck products and orchard products, the tonnage of those two amounting high in the millions. Neither did it include any figures for forest or mine products, nor for those things which go in wagons from the cities back to the country districts. Were all those included, one may easily see what a vast annual saving would be made. As it is, however, of the figures quoted above, at a saving of 13 cents per ton mile, the cash benefit to the farmers would be $58,900,000.

Beyond that, however, the Interstate Commerce Commission has assembled other freight figures, a most conservative estimate and most liberal deductions from their figures tending to prove that 250,000,000,000 pounds are annually hauled. By the same method of figuring as that adopted above, the hauling of this would result in a saving of about $305,000,000 a year. It would appear that so vast a sum should not be annually thrown away, simply because those responsible for appropriations of money to construct roads cannot be brought to a realization of their tremendous importance. The time for an awakening is here, and the quicker the awakening occurs, the greater the benefit the farmer will enjoy.

This Year's Nobel Prizes for Scientific Awards.

The latest awards made by Nobel's representatives for scientific work seem to be fair. Metchnikoff and Erlich receive conjointly the prize for valuable contributions to medicine. Of the two, the former is better known. A disciple of Pasteur, he has devoted much time to bacteriological research. His studies of the possibility of postponing old age have recently attracted attention to his work. Erlich is at the head of an institution for experimental therapeutics in Berlin. His investigations have for their object the successful fighting of several diseases—tuberculosis, diphtheria and anæmia among them.

Rutherford, who won the chemistry prize, is well known to our readers as an ardent and painstaking student of the phenomena presented by radium. Lippmann, who received the prize in physics, is a student of both acoustics and optics.

The Tuberculosis Exposition at New York.

The action of the Committee on the Prevention of Tuberculosis of the Charity Organization Society of New York in bringing to the American Museum of Natural History the remarkably comprehensive exhibit which was installed in Washington during the recent International Tuberculosis Congress, finds its justification in the fact that to nearly half a million people will be driven home the truth that tuberculosis is a communicable, preventable, and curable disease before the Exposition doors will close. The Exposition consists of models, charts, and specimens furnished by nearly seventy exhibitors, comprising foreign governments, our own Federal government, many of our States and municipalities, and private sanatoria and manufacturers. There is a certain amount of unavoidable repetition in these exhibits—unavoidable because, after all, an educational campaign such as this can be conducted only along certain lines. We refer particularly to the duplication of mortality statistics, of charts showing the methods of preventing consumption, and of tents, camps, sanatoria, and cottages for consumptives. Perhaps this very repetition has served to make more forceful the need of cleanliness and fresh air, and to convince the individual of his duty and relation toward the disease.

The Exposition shows the need of attacking the disease in the two fields, intestinal and respiratory. Scores of charts and models illustrate the methods of preparing food, and above all milk, without danger of infection. In this connection the remarkable exhibit of New York city's Department of Health deserves particular commendation. The Department has installed a model cow stable and milk room and proved very convincingly that cattle and stalls can be kept clean and milk safeguarded from germs. Moreover, the Department has exhibited by photographs and charts its method of inspecting the farms that supply milk to New York city and of testing the milk thus supplied. One comes away with the reassuring conviction that New York's milk is safe. The tuberculosis work now being carried on by the Health Department of the city of New York may be summarized as follows: (1) Notification and registration of all cases of tuberculosis (inaugurated 1894 and extended 1897). (2) Free bacteriological examination of sputum, to aid notification and to facilitate the early and definite diagnosis (1894). (3) Educational measures of various kinds, circulars, lectures, exhibits, newspaper articles. (4) Visitation of consumptives in their homes (1894). Continuous supervision of cases in tenement houses by the corps of trained nurses (1903). (5) Free disinfection by the Department of Health, and issuance of orders for the renovation of rooms vacated by consumptives (1894). (6) Furnishing milk and eggs, and referring cases to the proper charitable organizations (1903). (7) Three classes of institutions are provided: *a*. Free clinics (dispensaries) for ambulant cases unable to go to sanatoria (1904). *b*. Free sanatorium for incipient and early cases (1906). *c*. Free hospitals for advanced cases. (8) Forcing certain classes of patients into a hospital and retaining them there (1901). (9) Enforcing regulations concerning spitting in public places. (10) Research studies concerning the mode of infection, the role of bovine tuberculosis, characteristics of the tubercle bacillus, etc.

Because the public is probably more keenly alive to the need of pure fluids for the digestive tract than of the air that enters the lungs, it is but natural that the majority of the exhibitors have endeavored to show the value, and indeed the vital importance of fresh air. It is impossible in our brief space even to enumerate the models of sanatoria, houses, camps, devices for sleeping out of doors in cities, window tents, and the like which crowd the hall. All of them instruct the factory owner and the tenement house landlord that it is necessary to control the aerial transmission of phthisis germs, which flourish only when they find congenial soil in a subject already enfeebled.

The Exposition has been planned with the view that public education is more necessary at the present time that mere public medicine. It grinds into the public mind the fact that tuberculosis is caused by the neglects of society and the individual. Technical terminology is avoided so far as possible. The many lecturers who explain the exhibits and comment on statistics for the benefit of the thousands who come to the Exposition couch their discourses in simple, popular language. Naturally such education cannot but appeal to the overstrained, uncultured, struggling, and submerged fraction of society which suffers more from tuberculosis than the upper classes. A leaf has been torn from the book of the advertising merchant, if we may judge by the warning placards that hang from the walls. The wording is in all cases simple and terse. "Don't give consumption to others, don't let others give it to you;" "Consumption is caused by germs discharged from the lungs of consumptives when spitting, coughing, or sneezing;" "Fresh air, good food, and rest are the best means of curing and preventing consumption," are fair examples. The contracted thoracic cavity and inert lung, the seedbeds of the disease, are everywhere pictured, and likwise their susceptibility to dust.

The Exposition is not an isolated, incidental attack on a modern scourge, but a social development which the Charity Organization Society co-operating with legislators has started as part of a systematic programme of prevention. If that development progresses along the lines of the Exposition, it is evident that the State will some day wage the fight alone—for prophylaxis, prevention, and cure.

How to Destroy Explosives Safely.

The best way to destroy ordinary black gunpowder is to throw it into a stream under conditions that prevent any harm coming to human beings or animals through the dissolving of the saltpeter. If no suitable stream is available, the gunpowder may be stirred with water in tubs, or the dry gunpowder may be poured out on the ground in a long thin line and ignited with a fuse at one end.

To destroy dynamite cartridges, the paper wrappings should be carefully removed, the bare cartridges laid in a row with their ends in contact, and the first cartridge ignited with a fuse without a cap. Even with these precautions a simultaneous explosion of the entire mass may occur, so that it is wise to retire to a safe distance. The row of cartridges should be laid parallel with the wind and ignited at the leeward end, so that the flame will be driven away from the mass. Frozen dynamite should be handled with especial care as its combustion is peculiarly liable to assume an explosive character. A small quantity of dynamite may be destroyed by throwing it, in very small bits, into an *open* fire, or the cartridges may be exploded, one by one, in the open air, with fuses and caps. Dynamite should never be thrown into water as the nitroglycerine which it contains remains undissolved and capable of doing mischief. Other explosives which contain nitroglycerine should be treated in the same way as dynamite.

Ammonium nitrate explosives may be thrown in small fragments into an *open* fire or, if they do not contain nitroglycerine, may be destroyed by means of water. Explosive caps should be exploded singly with pieces of fuse.