Sirius is flashing near the western horizon while the brilliant Vega is rising in the northeast.

Nearly overhead shines the Great Dipper, and south of it appears the softly twinkling Berenice's Hair. East of the latter is Arcturus, a royal star in brightness and color, while between Arcturus and Vega glitters the pure white Spica in the constellation of the Virgin.

Among the easily observed double stars now favorably placed are γ Virginis, ε Boötis, Mizar in the middle of the Dipper's handle, γ Leonis, and Castor, the great double in Gemini.

THE CONTEST BETWEEN SHOT AND ARMOR.

At the present writing it looks as though the superiority of shot over armor was proved, and that unless some new method of treating the plate be devised, the gun will have the armor at its mercy. That is to say, it will at the proving grounds; whether the hazard and confusion of a sea fight will very often afford the ideal conditions for penetration is open to question. The twelve inch side armor of the two Chinese battleships, which bore the brunt of the Japanese attack at the Yalu, was struck repeatedly; and yet no shot made a deeper penetration than four inches, although the three leading Japanese ships were armed with a gun—the 66 ton Canet rifle—which was credited with the highest power of penetration of any in the world. It is certain that, during the many hours that the fight lasted, some of the shots from these big guns must have struck the armored portions of the Ting Yuen and Chen Yuen. Judged by proving ground results, any one of these shots should have easily penetrated the belt, and wrecked the "vitals" of the enemy.

Now all this goes to show that the gun versus armor contest must not be judged from the results at the target alone. In target firing the gun has everything in its favor. The range is accurately known; the target is stationary; and the shot is delivered normal to the face of the plate. In a sea fight the range is uncertain; the target is moving; and the face of the armor will very seldom be struck squarely by the shot—this last being an element in favor of the armor of greater value than is generally supposed. To this, we think, more than to any other cause, must be attributed the surprising powers of resistance shown by the out-of-date armor plates of the Chen Yuen and her mate.

The history of the development of armor plate dates from the Crimean war and the war of the rebellion. In its earlier stages, the advantage lay with the armor. Penetration was comparatively rare; and in the attacks upon the Russian forts in the Black Sea, and upon the Southern batteries, the side armored vessels proved comparatively invulnerable to the round shot and shell of that date. The gun crews on the floating batteries suffered, as a rule, no greater inconvenience than the rattle of the round shot as it fell harmlessly from the iron plated sides of the vessel. Even the great 15-inch shot from the Rodman smooth bores could not get through. For a while, iron armor held the field. Then came the so-called conical shot, the long rifled gun, and the resulting increase in velocity; in the presence of which the thin plates of iron proved to be helpless.

Armor plate makers tried the next natural expedient, and made the plates thicker; and, as these plates were successively penetrated, they kept adding to the thickness until, in 1881, when the British Inflexible was floated, she carried no less than two feet of solid iron upon her sides. Difficulties of manufacture and the excessive weight of such armor led to the adoption of steel in place of iron. Here, however, the brittle nature of the steel presented a difficulty, and an attempt was made to combine the hardness of steel and the toughness of iron in what is known as the compound plate. This consists of a plate which is made up of an extremely hard steel face upon a softer iron backing. The idea of this device was that the steel face would provide the resistance to penetration; and that the iron backing, upon which the steel was welded, would prevent the steel from cracking; or, should it be cracked, it would keep it from falling to pieces.

The theory was plausible; but the results obtained in trial have been very disappointing; the steel face cracking and flaking off from the backing in most alarming fashion. The failure of the compound plate left the field open to the "all steel" advocates, and for the manufacture of a perfect plate there was only wanting some process by which the steel could be toughened without losing any of its hardness. This process was found in the nickel steel armor, in which the introduction of a proper percentage of nickel gave a remarkable toughness to the steel, without impairing its resisting powers. Shots were put through the test plates without producing those radiating cracks which at the second or third penetration had resulted in complete demolition.

Meanwhile the gunmaker had not been idle. Increased length and smokeless powders resulted in increased velocities; the penetration per ton of gun grew steadily larger; and the thickest steel plates succumbed to a caliber of gun which a few years before would never have been thought of as capable of piercing heavy armor.

The victory now lay with the gun.

It was reserved for an American inventor, whose name will forever be famous in the annals of the armor plate industry, to introduce a process which turned the tables entirely, and placed the advantage strongly on the side of the plate. The Harvey process, which is named after the inventor, seeks to present intense hardness of face, rather than thickness of metal, to the shot. The inventor realized that it was useless to attempt to resist the enormous momentum of modern ordnance; and that the only way to meet that momentum was to break up the material of the shot at the moment of impact. This he accomplished by making the face intensely hard, so hard, indeed, that it was capable of cutting glass. The Harveyized plates were a success from the very first. Shots which theoretically should have easily passed through a plate flew to fragments at the moment of impact.

For some few years the new plates remained practically impregnable against the hardest projectiles. Various systems of shot hardening have been tried, but with limited success; and it is only within the past few months that the gun makers have been able to regain their old ascendency. The first whispers of successful penetration came from Russia, where shot, which had been made on a "secret process," were reported to have passed through Harveyized plates without breaking up. What the process was can only be surmised; but the recent remarkable tests at the United States proving grounds at Indian Head make it probable that some form of what is known as the "soft steel cap" was used on the projectiles.

In these tests, and also the tests at the same grounds last October, the successful shot were "capped," that is to say, the point of the projectile was covered with a soft steel cap. The theory of this device is that when the point of the shot strikes the plate it will be prevented from flying apart by the surrounding metal of the cap. When the point has once entered the hard face of the armor, it is held together by the metal of the plate itself, and the shot can then expend the energy of its unbroken mass upon the body of the plate.

In the experiments of October last a Harveyized plate, which had broken up the ordinary 6 inch shot, was cleanly perforated by four 6 inch capped shot. The experiments now in progress with heavier 8 inch and 12 inch shot will be watched with keen interest, and thus the final advantage seems to lie with the gun.

Roentgen Photography.

In a recent Franklin Institute paper, Drs. Edwin J. Houston and A. E. Kennelly gave the following directions for using the ordinary alternating lighting current for X ray work. To the primary terminals of an induction coil are connected leads from a 50 volt alternating current circuit. The secondary of the induction coil connects with a battery of Leyden jars and with the primary of the Tesla coil. The Tesla coil is made by winding about 80 turns of No. 19 cotton covered wire on a glass tube about ¾ inch in diameter. Over this is passed a slightly larger glass tube wound with about 400 turns of No. 31 silk covered wire. The whole is immersed in a jar of resin oil. The Crookes tube is connected to the secondary of the Tesla coil. This arrangement gives the disruptive discharge, which is of increased effect and less likely to injure the tubes. The discharging electrodes of the induction coil are placed about 5 mm. (0·2 inch) apart. To secure sharp images the use of a metal plate perforated and used as a diaphragm is recommended.

Nikola Tesla has continued his experiments on reflection of X rays from different materials, using an angle of incidence of 45° as the most crucial test. Each sample was tried simultaneously as to its power of reflecting and transmitting the incident ray. Zinc, mica, tin and lead were the best reflectors. Aluminum reflected no appreciable portion of incident rays. There was no corresponding order in transparency to the rays. Zinc, tin and lead proved opaque; mica transparent. He upholds as his view that the X rays are both cathodic and anodic. He has obtained good results by using a zinc reflector for his tubes. He announces that he has not found the least evidence of refraction.

MM. Darieu and De Rochas have tested an eye, which was placed upon a plate holder with two fingers beside it. The X rays were then produced and a photograph taken. The eye proved intermediate in opacity between bone and muscular tissue. The rays passed axially through it.

A very interesting line of work has been initiated by Mr. H. I. Dreschfield, L.D S., of Manchester. He used X ray photography to show the development of the second set of teeth in a living subject, a boy about thirteen years old. He succeeded in obtaining a photograph showing the first set of teeth in place and the second set still in situ in the bone back of and above the others.

It is definitely stated that X rays were used in Vienna to determine whether a wrapped mummy contained the remains of an ibis or of a human being. The process showed it to be the mummy of an ibis.

A very ingenious attempt to measure the intensity of the X rays is due to Prof. R A. Fessenden and Prof. James Keeler, Western University, Pittsburg, Pa. They immerse the ends of two terminals of a circuit in paraffin, the ends being about one-half inch apart. The X rays are then caused to pass through the paraffin and their effect in causing an electric discharge to pass is used as a measure of their intensity.

Prof. Rowland, of Johns Hopkins University, and Elihu Thomson both appear as enunciators and upholders of the hypothesis that X rays are of the anodic order, and not of the cathodic order. Thomson found that no X ray effect could be obtained from an excited tube when the anode and a fluorescent screen had a patch of opaque metal interposed upon the glass of the tube between them, although the cathode was unscreened. Anode rays he found to be erratic in distribution from the anode, and to require very high exhaustion for their production. He says that it is fortunate for science that the Crookes tube used by Roentgen had a high enough vacuum to give anodic rays.

Cost of Bad Roads.

According to statistics collected by the office of Road Inquiry of the Department of Agriculture, the amount of loss each year by bad roads of the country is almost beyond belief. Some 10,000 letters of inquiry were sent to intelligent and reliable farmers throughout the country, and returns were obtained from about 1,200 counties, giving the average length of haul in miles from farms to markets and shipping points, the average weight of load hauled and the average length per ton for the whole length of haul. Summarized, it appears that the general average length of haul is twelve miles, the weight of load for two horses 2,002 pounds, and the average cost per ton per mile 25 cents, or $3 for the entire load.

Allowing conservative estimates for tonnage of all kinds carried over public roads, the aggregate expense of this transportation is figured at $946,414,600 per annum. Those in a position to judge calculate that two-thirds of this, or nearly $631,000,000, could be saved if the roads were in reasonably good condition. At $4,000 per mile a very good road can be constructed, and if an amount equaling the savings of one year were applied to improving highways, 157,000 miles of road in this country could be put in condition. The effect of this would be a permanent improvement, and not only would the farmer be astonished in the sudden reduction in his road tax, but he would also wonder at the remarkable falling off in the cost of transportation. He would also find that he required fewer horses and less feed for them. He could make two trips to market a day instead of one, when ability to get his goods there at a time when high prices are ruling is a matter of great consequence. Farmers are beginning to apply a little simple arithmetic to some of these matters, and it is not too much to expect that in the near future we shall see a decided revolution in the condition of our rural highways.—New York Recorder.

Value of Farm Animals.

According to statistics published by the Department of Agriculture at Washington, says the Iron Age, the aggregate value of farm animals in the United States has declined very materially in recent years. At the present time the value of these animals is $755,580,597 less than it was in 1893. The decline is more particularly observable in the case of horses. Taking the seven years from 1890 to 1896, it is shown that horses increased in number until 1893. In 1892, however, their value began to fall off, and in 1895 it was not quite half that of 1892, showing an aggregate decline in this respect of about $500,000,000. This depreciation is attributed in the main to the introduction of trolley cars and bicycles. The high cost of fodder, however, after recent seasons of drought, is also given as a contributing cause. The value of mules since 1890 has fallen nearly $80,000,000, or not far from half the total existing value of these animals in the United States. On the other hand, milch cows have increased in numbers, while the average value of these animals has advanced steadily within the past few years. The increase in the value of milch cows last year, as compared with 1894, is $1,300,000. Oxen and other cattle decreased in numbers more than 2,000,000 in 1895, while their value increased on an average $1.80 a head in the same period. A decline is noted in the numbers and value of sheep in the last three years, the decrease in value aggregating about $60,000,000 and the falling off in numbers of these animals last year being nearly 4,000,000. Swine, in 1895, declined 3 per cent in number and 15 per cent in aggregate value, the total decrease in the value of swine in 1895 being nearly $33,000,000. It is expected, however, that the enormous corn crop of last year will have a favorable effect upon the next statement of farm animals, the tendency to an increase in numbers and value being already observable.