

been reduced by one-third. The commander of the battery finds it no light task to instruct the men with so limited a time at his disposal. Moreover, the short time allotted for target-practice during summer renders it extremely difficult to give thorough instruction.

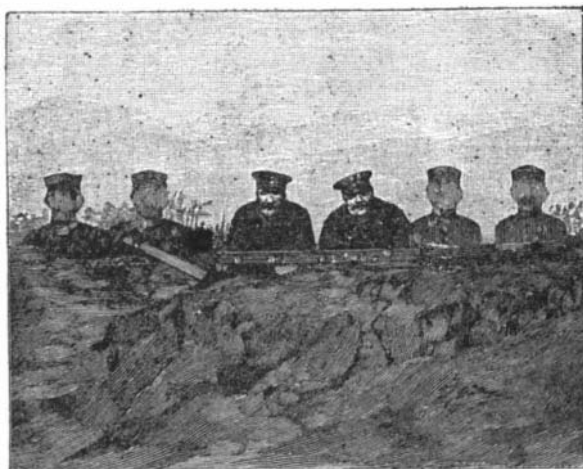
These obstacles have, to a certain extent, been overcome by the reorganized training-school. Annually about 500 officers in every branch of the service pass a certain length of time at the school. With the exception of the Bavarian subaltern officers, who have their own school at Lechfeld, the officers of all the German contingents must go to Jüterbog. The batteries are manned by selected non-commissioned officers and crews and drawn by well-trained horses, so that the commanding officers are in no way hindered in learning how most effectively to use their weapons.

Mobile almost as a body of cavalry, a battery can traverse a country at a high speed; no ditch, no hill can stay its course. Utilizing every cover, every bit of shady woodland, the six pieces finally take up a position which commands the battlefield. A few commands and motions are given, and immediately the rear guns swing from right to left out of the column. Reducing its gait from a rapid gallop to a speed which is better suited to the character of the country, the battery halts behind the flat crest of a hill. After unlimbering, a shot immediately thunders forth. This first shot, fired at a range of 4,000 yards, falls short of the mark. "Four thousand four hundred" is the next command uttered. Fifteen seconds later a cloud of dust is cast up by a shrapnel-shell and a hostile gun, half-hidden, is exposed. The wind slowly blows away the smoke, and soon the next gun, and the next in the enemy's trenches appears. The officers in the firing-line point to bushes, to bits of shrubbery, to trees which enable the gunners to train their weapons with greater accuracy on the enemy's position. Then the enemy opens fire; for he knows that concealment is no longer possible. "The first gun is mounted in front of the barn," cries the commander, and fires his third shot at a range of 4,200 yards. A glance through his powerful field-glasses shows that the shot has fallen somewhat short of the mark. The fourth shot again exposes the hostile gun; for it has been fired at a range of 4,300 yards. The commander now knows that he has pinned his enemy in a fork, one prong of which is 4,200 yards long and terminates in front of the target, and the other of which is 4,300 yards long and extends behind the target. After having thus accurately determined the position of the enemy, the real bombardment begins. The order is given to cease firing. The men are then ordered to distribute their shot and to fire at 4,200 yards. Each gun is sighted for a corresponding piece in the enemy's battery; and the observations show that each shot has told. The next orders direct the men to fire their shrapnel directly over the enemy. As each shell explodes, 300 leaden balls are scattered among the hostile gun-crews. The fire is then slackened in order that the effect of the shots can be better observed. Shell after shell whistles through the air; after every shot the piece recoils. With modern quick-loading devices and smokeless powder, a well-trained battery can fire 50 shots per minute. An enemy's guns can be put out of action in the manner we have described, even in unfavorable weather, in about ten or fifteen minutes.

The German army has ever been trained to act on the offensive, while most European armies are trained to act on the defensive. In order to protect themselves from the terrible effect of German shrapnel, other forces resort to natural and artificial covers, trenches,

ment has added to each army corps three batteries of field howitzers so as to enable the artillery to cope with every emergency. The uniformity of armament which had previously been one of the characteristics of the German army was destroyed, it is true; but the increased efficiency of the artillery has overcome whatever objections were once made.

Instead of a barrel $6\frac{1}{2}$ feet in length and 3 inches diameter, as in the field-gun, the howitzer has a short 4-inch barrel which can discharge a shell at such an elevation that the trajectory will be a curve, the highest point of which is at a considerable elevation from the ground. The shell, therefore, plunges at a very slight inclination from the vertical down through the earth and timber covering of a trench and bursts in the very midst of the enemy. The weight of the ammu-



FRIEND AND FOE IN THE RIFLE-PITS.

nition used in the howitzer (each shell weighs 44 pounds) limits the sphere of the weapon's action, since in modern field operations it is extremely important that the guns be served as rapidly as possible.

Since the school was founded, each shot fired has been registered. In every battery an officer is detailed to note every circumstance attending the firing of a shell, the elevation of the gun, corrections for the sights, adjustment of the primers, etc. Near each target an armored turret or other protected structure is erected in which an officer is stationed whose duty it is to note the number of hits and their effect, and to gather other statistical information which may be of service. Before practice begins, he inspects his end of the ground, examines the enemy (comprising a number of painted dummy-figures) and decides to his own satisfaction whether the conditions approximate, as closely as possible, those under which an actual battle would be fought. Men stationed at other points telephone to the commander of the battery when the ground is clear. After target practice is over, the results obtained are chalked down on a huge blackboard in the presence of all the officers.

WEB-SPINNING OF THE RED ANT.

MR. E. G. GREEN, government entomologist at the Botanic Gardens at Peradeniya, Ceylon, has recently

the worker ants, and its movements directed as required. A continuous thread of silk proceeded from the mouth of the larva, and was used to repair the damage. There were no larvæ among the occupants of the disturbed inclosures, and the grubs used for spinning were apparently obtained from a nest a short distance away, which probably accounts for the considerable time that elapsed before the rent was repaired.—Nature.

"EXCHANGE VALUE" OF METEORITES.

By L. P. GRATACAP.

THE strange relation to our earth of those occasional visitors from space which science has placed under the generic designation of meteorites, has never excited more discussion than to-day. Their collection becomes almost a species of mania in those devoted to their study, and the extravagant effects of having anything to do with them might not unnaturally, in an irreverent mind, lend weight to the theory of their lunar origin.

These curious evidences of our chemical identity with the extra-terrestrial creation, have in late years, perhaps, as a convenient simplification of astronomical distinctions, been referred to the same origin as the shooting stars. These latter, as separated particles of disintegrated worlds, or the trailing dust of planets, meet our atmosphere and are burnt to powder, leaving no substantial residue to reach the surface of our globe, whereas the meteorite is more fortunate, and brings us its metallic and mineral burden, snatched, as it were, from the abyss of space for our instruction.

Among the American collectors of these celestial missiles none has made more strenuous efforts to secure examples of the numerous falls than Prof. H. A. Ward, of Rochester. He has traversed the world, traveling up and down and across its wide surface, led by the magnet of their attraction, until, after experiences as varied as Sinbad's, and expenditures as costly as Cecil Rhodes', he now easily leads American collectors in the number and quantity of his specimens.

The Ward-Coonley collection contains examples of 424 falls, distributed as follows:

North America.....	174
South America	18
Europe.....	154
Asia.....	48
Africa.....	12
Australia.....	18

The total weight of the collection reaches 1,399,094 grammes or 3,084½ pounds. While there are in this collection no such preponderant masses as the Peary meteorite, now at the Navy Yard, and presumably weighing over twenty-five tons, nor such royal masses as the larger examples in the British Museum, there are large fragments, and, in some cases, entire falls. Among the former may be cited the iron (siderite) from Cañon Diablo, Arizona, the iron and stone meteorite (sideralite) from Brenham, Kiowa County, Kansas, and the stone (aeralite) from MacKinney, Collin County, Texas. Among the latter the aerolite from Kansas, Ness County, Kansas, the siderite from Mukwonago, Wisconsin.

But while the recent prominence given in this country to the Ward collection naturally offers an occasion for alluding to these cosmic bodies, it is opportune that almost simultaneously appears an exhaustive work (published in 1897) on Meteorite Cabinets by Dr. E. A. Wülfing, of the University of Tübingen. To the great number, to whom meteorites are both inferentially and practically of interest, attention to this valuable essay cannot be too strongly recommended.

This work is a catalogue enumerating in alphabetic order the known falls of meteorites, with extensive references to the literature of each fall, and a table of the weights of examples now to be found in different collections under each entry. The American collectors, Bailey, Bement, Kunz, and Ward appear significantly throughout.

Perhaps one of the most useful features in this work is the painstaking effort made by the author to determine what he calls the "exchange value" of every prominent fall, or indeed of any fall about which sufficient data can be supplied to furnish him with the necessary elements for a calculation.

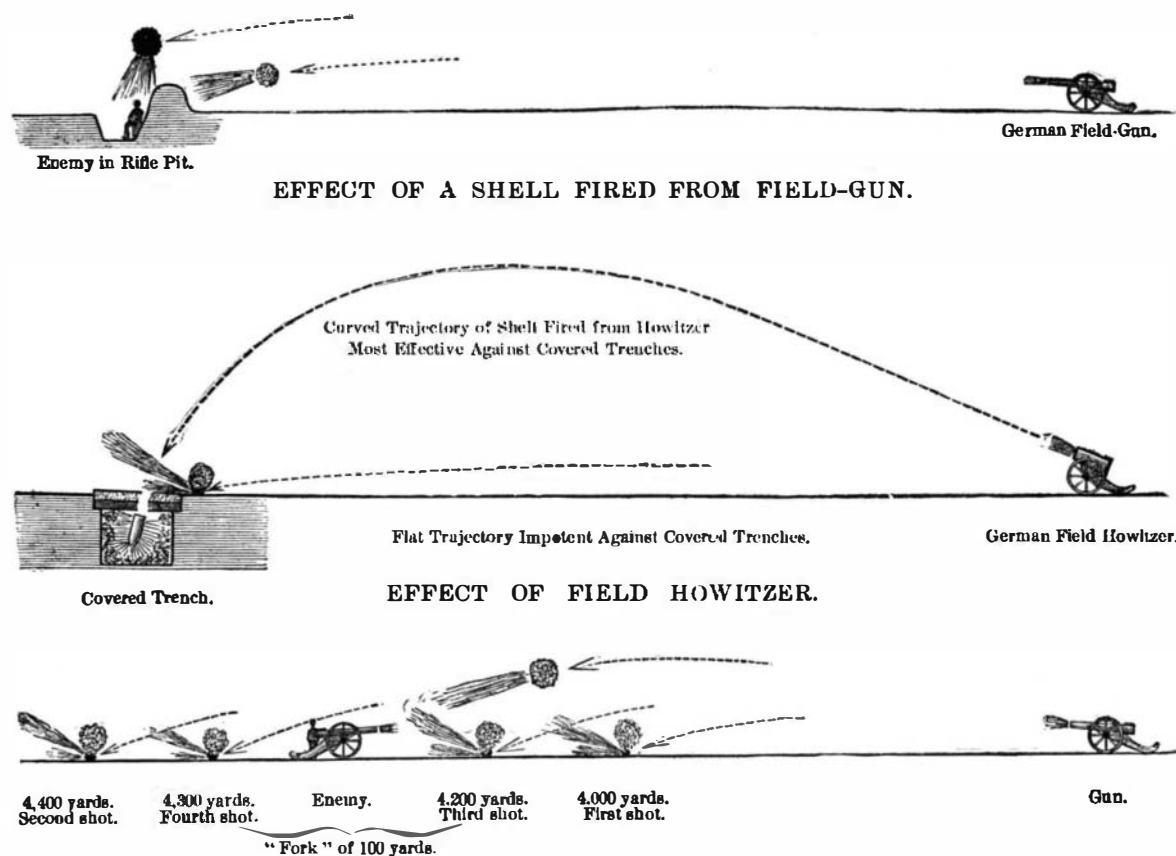
Dr. Wülfing considers that the value of a meteorite initially depends upon the original size of the fall. The smaller the fall, from the less amount of material to be distributed among collectors, the greater the "exchange value."

Secondly, he places as a determinant of value the rarity of the class of the meteorites to which any fall under discussion is to be referred. When the class is numerously represented among known falls, the value of the specimen sinks, and vice versa, as in the case of such an aerolite as Augra das Reis Brazil, belonging to the rare group of the lime and aluminous stones, almost destitute of iron, and not characterized by chondrules, small spherical grains of varying sizes, the value rises. As an auxiliary consideration the number of collections containing examples of any given group deserves mention, as the more widely distributed the less value should be assigned to one group, in comparison with another whose actual group weight might be almost the same.

The third factor which enters into the formula of Dr. Wülfing is just this question of distribution. If of one meteorite there are five possessors the material would have a diminished value as compared with a similar body divided between two.

These are the essential elements upon which the equation, given for determining "exchange value" of a given meteorite is based. There are brief modifying considerations which, however, have not sufficient determinate force to be considered effective in making up the formula. These are the probable recurrence of similar falls in the future; the expense attendant upon securing a specimen of any fall; the condition, unchanged or decomposed, of meteorite; the historical interest of a fall; and, lastly, the fact of observation of the fall, there being about nine irons actually seen to fall.

Indicating the "exchange value" of a meteorite by W , its entire known weight by N , the added weight of all meteorites belonging to the same group or class, as the specimen considered, by G , and the number of col-



SCHEMATIC REPRESENTATION OF TARGET PRACTICE.

and field fortifications. Since the parapet of a trench will receive most of the balls of an exploding shrapnel, Germany is now using a shell which is timed to burst directly over the trench, so that the projectiles will, like dynamite, be discharged downwardly. In the French army, the effect of this shell is counteracted by field-fortifications in which beams and earthworks are so arranged as to protect the artillery from the shell bursting in front of or above the trench. Under these conditions the effect of a shell whose trajectory is flat is very small indeed. Despite the protests of many old and experienced army officers, the German war depart-

ment has been able to confirm by personal observation the web-spinning habits of the red ant (*Ecophila smaragdina*). He has seen ants actually holding larvæ in their mouths and utilizing them as spinning machines. To find what would be done, some leaves which had been newly fastened together by the ants were purposely separated by Mr. Green. The edges of the leaves were quickly drawn together by the ants, and, about an hour later, small white grubs were seen being passed backward and forward across the gaps made in the walls of the shelter. Each grub (there were apparently only two of them) was held in the jaws of one of

lections through which the same meteorite is distributed by B. Dr. Wülfing furnishes us with the approximate formula :

$$W = \frac{1}{f(GNB)}$$

It remained to determine the function f and the following forms of the equation were reviewed :

$$W = \frac{1}{GNB}$$

$$W = \frac{1}{\sqrt{GNB}}$$

$$W = \frac{1}{\sqrt[3]{GNB}}$$

$$W = \frac{1}{\sqrt[n]{GNB}}$$

Solving these with the best available information, the author finds that the cube root gives the most reasonable and acceptable results. So that with data, under the foregoing definitions, sufficiently well determined, the formula $W = \frac{1}{\sqrt[3]{GNB}}$ will give the

anxious possessor of meteorite material a valuable basis for measuring the relative "exchange values" of different falls. This must prove a distinct boon. Dr. Wülfing gives in the closing pages of his treatise his determinations of W for the best known falls.

THE DWARF OF HAIPHONG.

THE accompanying engraving, borrowed from La Nature, is a reproduction of a photograph of a dwarf living at Haiphong, Tonkin.

His name is Nguyen Yan Bang, or, familiarly, "Jo-



THE DWARF OF HAIPHONG.

seph," and he is forty-five years of age. He was born at Dan-Oap-Xa, Nhuyen de Than Nien, province of Haiderong. His height is 3-28 feet (which, to tell the truth, is not a very small stature for a dwarf) and his weight 53 pounds. Nguyen Yan Bang lived with his parents up to the age of twenty years, but, being fond of work, industrious and very intelligent, he became first a mandarin's interpreter at Saigon from 1880 to 1887. After this, from 1892 to 1899, he was attached to the customs service as overseer at the docks of Haiphong. In the years intervening, that is to say, from 1887 to 1892, he became a dealer in wood and then a laundryman, a business that he prefers, since he relinquished all others to engage in it, and is engaged in it still.

He has been married three times. He has had four daughters by these different marriages, three of whom are living and in robust health at the present time. Their ages are respectively 14, 11, and 3 years. They are seen standing behind their father in the engraving.

Mme. Nguyen Yan Bang, the dwarf's third wife, is seen standing to the left of her husband and embracing her little three-year-old daughter. The father stands upon a pedestal formed of a soap box.

TONING FORMULÆ.*

A FEW weeks ago I had the opportunity of watching a photographer of no small repute carry out his toning operations. On asking what bath he used, he said: "I just fill the dish with water, throw in as much borax as will lie on a sixpence, and then add a few drops of gold." Needless to say, his talents lie in artistic, not scientific, work.

One of the most frequent troubles the novice first experiences is undoubtedly toning, the result often being that he uses the "combined bath," only to find his cherished photos fade sooner or later—generally sooner. The chief complaints made against separate baths are (1) The possibility of double tones, and (2) that the prints sometimes turn yellow and remain so. Such obstacles may easily be removed by exercising a little care. Double tones may be prevented by soaking the prints in a ten per cent. solution of common salt before the preliminary washing, and by not touching the

films with the fingers; and the second objection could not be raised provided fresh solution were used, with no excess of sulphocyanide, if this be the bath adopted.

Although it is agreed upon generally that the sulphocyanide bath gives the most excellent results, there are a great many others which are far more easily manipulated. For instance, the gentleman above mentioned, no matter how unscientific his methods may be, has never known a double tone; and besides the borax bath, there are several others which may be used with advantage.

A very satisfactory solution may be made as follows:—

Sodium phosphate..... 20 gr.
Gold chloride..... 1½ gr.
Distilled (or boiled) water..... 10 oz.

This tones very quickly and evenly, and the print will be, when fixed, exactly the color it is when removed from the bath. Good chocolate tints may be obtained, turning to purple-gray on prolonged immersion.

Next to this, as regards ease of manipulation, the tungstate bath may be placed, the following being a good formula:—

Sodium tungstate 40 gr.
Gold chloride..... 2 gr.
Water 12 oz.

The prints should be toned a little further than required, as they change color, though only slightly, in the hypo.

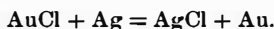
Provided that ordinary care be exercised, the sulphocyanide bath cannot well be improved upon. The formulæ given by the various makers for their respective papers are all satisfactory, and differ very little. One which I have always found to act well is—

Ammonium sulphocyanide..... 28 gr.
Distilled water..... 16 oz.
Gold chloride..... 2½ gr.

For those who care to try the various baths, and to compare their results (which, by the way, is well worth doing) I give below a table showing the quantities of different agents that may be used with sufficient water to make up ten ounces.



We may take it that any of these substances reduce gold tri-chloride, $AuCl_3$ to $AuCl$; this $AuCl$ apparently acts as an electrolyte, from which gold is deposited on the silver of the image, and at the same time a small quantity of silver combines with the chlorine of the gold chloride thus:



When toning has been completed, the prints are washed and placed in the fixing bath, when the sodium thiosulphate present dissolves any silver chloride that has not been affected by light.

Besides the well-known, every-day tones we see, which never outstep the narrow range between choco-

Gold chloride, 1 gr. to 1 oz. water.....	12 dr.	16 dr.	16 dr.	11 dr.	11 dr.	14 dr.
Borax.....	60 gr.					
Sod. bicarbonate.....		10 gr.				
Sod. carbonate.....			20 gr.			
Sod. phosphate.....				20 gr.		
Sod. tungstate.....					40 gr.	
Amn. sulphocyanide.....						17.5 gr.

late-brown and purple, a practically infinite variety of color, from chalk-red to black, may be obtained by a little careful study of toning baths instead of regarding them as mere unalterable machines. Most charming tints are produced with platinum baths, a good formula being—

Strong nitric acid..... 5 drops.
Water..... 4 oz.
Chloro-platinite of potassium..... 1 gr.

The final tone of a print cannot be judged from its appearance in the bath, but some idea of it may be got by holding it up to the light and looking through it. A short immersion gives various reds, while prolonged toning gives soft grays.

Results very similar to platinotype may be obtained with the following combined gold and platinum bath:—

A.—Sodium acetate..... 1 dr.
Water..... 4 oz.
Gold chloride..... 1 gr.
B.—Chloro-platinite of potassium..... 1 gr.
Water..... 4 oz.

Mix A and B and neutralize with nitric acid. (The solution will be neutral when it just ceases to turn red litmus paper blue.)

Another toning agent is stannous chloride. Two or three grains of tin-foil are dissolved in strong hydrochloric acid with the aid of heat. The whole is then made up to about four ounces with water. I have some prints toned with tin over two years old, which so far shows no sign of fading or discoloration.

Much as the combined toning and fixing bath is to be condemned, it may yet be safely used, provided that very great care be exercised in the final washing. But the little trouble it saves is certainly not worth the risk of fading it necessarily involves. A combined bath without gold is as follows:

Lead acetate..... 20 gr.
Hypo..... 1 oz.
Water..... 10 oz.

In this the lead takes the place of gold, and, therefore, the results are not permanent.

THE AUTOMOBILE WAGON FOR HEAVY DUTY.*

By ARTHUR HERSCHMANN, New York City, Associate Member-Elect of the Society.

IT can be easily proven that the progress of civilization made by all nations has been closely interwoven with the progress of transportation. In olden days men were well satisfied to live, grow, and end their days wherever destiny planted them. There they established themselves, contented with the pursuits of life which were within easy reach, looking to Nature for their maintenance, and buying and trading with their immediate neighbors, and within narrow bounds. It would be outside the scope of this paper to discuss whether life was then less comfortable than it is today, and whether the few commodities then obtainable were sufficient to make existence enjoyable.

At the present day our needs are considerable, varied, and ever increasing. It is no exaggeration to state that many a person's happiness is marred for a good many hours if an express package containing personal goods coming from a great distance should not arrive on the hour.

We all know how an improvement in the facilities for rapid passenger transit shifts the centers of districts where people congregate to manufacture, and the districts where they gather to live. Towns prosper or decay according to transportation facilities, and the value of real estate is seriously affected by them.

The manufacturer and the farmer know what it means to buy and sell where the opportunity is greatest, and how important the item of a quick, safe and economical transportation of their goods has become at the present day, when the fluctuations in the value of raw material have become an ever-increasing factor in the cost of the finished product.

Before the advent of the railroad overland transportation was limited to the public highways. Washington maintained that the future prosperity of the country would depend on more horses and national roads, and it can be well said that his prediction has been fulfilled if we only substitute for the word "horse" the words "motive power." When, long after Washington's days, the locomotive appeared, the prevailing idea was that there would be little further use for horses, and that all traffic would soon be handled by steam roads. It was different. The fact became apparent that traffic begets traffic, and that the increased opportunity which the railroad presented stimulated local enterprise and necessitated the employment of more horses and wagons to ply to and from railroad stations. It can be safely stated that the amount of merchandise hauled by horses on our streets and over short distances is as great in the aggregate as that carried by the railroads over long distances.

The advent of the bicycle and of the electric trolley car characterized similar periods of apprehension on similar lines, and yet statistics show that the number of horses in use has so far been little affected.† However, it bids fair that with the advent of the motor carriage this increase may now be checked, to give way gradually to a diminution in the number of horses used. Some enthusiasts have already predicted that it will be only a few years before there will be no horses on the streets. This sanguinism is not justified. However, while the horse will continue to remain man's best friend among the brute creation as a saddle horse, and will probably never be wholly substituted in the propulsion of fancy carriages, there can be little doubt that the motor freight vehicle has come to stay and will eventually supersede the horse as a beast of burden. It will evidently be a question of some time and evolution before it will become a universal institution and of the greatest importance to transportation interests.

The motor wagon presents a problem which should admit of no prejudice. It is a case free from sentiment, and merely influenced by economic considerations. The elements constituting in principle a successful motor vehicle were known and experimented with by enterprising engineers some eighty years ago. The reasons why those experiments did not lead to results are not far to seek. It was then the time of railroad development, and the new competition from the railroad did not encourage costly experiments in a competitive line. Furthermore, the machinery used in the motor carriages was in a crude and undeveloped state. The revival of the movement, which may be said to have begun not more than ten years ago, has met with a great deal of indifference and prejudice. It has been contended that these wagons would frighten the horses, while we can say to-day that most horses soon become accustomed to the peculiarities of their new competitor. Most of this opposition has come from prejudiced quarters; many of the opinions have been volunteered by persons who had never ridden in a motor carriage, and whose remarks were intended for consumption by the home circle. The advantages of any kind of self-propelled vehicles are patent to any one who stops to give the matter un-

* Presented at the Cincinnati meeting (May, 1900) of the American Society of Mechanical Engineers, and forming part of vol. xxi. of the Transactions.

† Horses in United States on January 1, 1893, about 16,000,000, on January 1, 1899, decreased to about 14,000,000.

* By T. Thorne Baker, F.R.P.S., in The Amateur Photographer.