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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

LARGE POWDER CHAMBERS AND GUN EROSION.

We direct attention to the significant facts regarding the relation between the size of the powder chamber and the pressures and velocities of guns, to which reference is made in a letter published in our correspondence column. The facts relate to the government tests of the Brown wire gun, which were recently completed at the army proving grounds at Sandy Hook. Simultaneously with these tests, another high-powered, wire-wound gun, designed by Gen. Crozier, was subjected to similar tests. Both of these guns developed powder pressures, velocities, and energies, far in excess of anything officially recorded, as far as we know, for guns of 6-inch caliber, at any of the government or private testing grounds either here or abroad. In both pieces, velocities were run up to a figure hundreds of feet per second greater than the generally accepted maximum service velocity of three thousand feet per second, which is considered to be about the limit for guns of this caliber. As was to be expected, in the case of both guns the high powder pressures developed produced severe erosion. This pressure in the case of the Brown wire gun reached the high limit of 32 tons to the square inch in the powder chamber, with a corresponding muzzle velocity of 3,740 feet per second.

Those of our readers who have followed the current discussion in our columns will remember that we have always considered that erosion was chiefly due to the escape of gases past the projectile, the leakage being due to the failure of the copper rifling bands to properly fill the grooves of the rifling. A strong presumption that this view is correct is offered by the experience gained during the tests of the two high-powered guns above referred to; for under the fierce heat and enormous pressures involved, the scoring was so excessive that, in the last rounds, the projectiles from one of the guns failed to rotate properly, and the shells tumbled end over end. In firing the last ten rounds with the Brown gun, under excessive pressures, the average for these rounds being 55,000 pounds per square inch, and the average velocity over 3,600 feet per second, Mr. Brown, the inventor of the gun, with a view to preventing the escape of the gases and securing a good grip on the already badly worn rifling, provided the shells with rifling bands of much greater size than those used in the earlier rounds. This experiment was highly successful, the projectile making a true flight, and the extraordinarily interesting and valuable fact being developed, that the progress of the erosion in that portion of the gun not already seriously affected, was practically stopped, the star gaging records of the government report showing that there was practically no erosion at all in the last fourteen feet of the muzzle end of the gun.

"One swallow does not make a summer"; but here, surely, is a fact which should give food for careful thought and prolonged investigation before gun erosion is placed among the class of incurable diseases.

To the ordnance expert, however, the chief interest will be found not so much in the last ten rounds at high pressures, as in the earlier rounds fired with lower pressures and more moderate velocities. For in these rounds the surprising fact was developed (although, strange to say, it seems to have been entirely overlooked) that in guns like those of the Crozier and Brown type, provided with unusually large powder chambers and charges, it is possible to secure high velocities with very moderate pressures, 2,879 foot seconds being obtained with only 28,475 pounds pressure, in the Brown gun, and, in the Crozier gun, 2,938 foot seconds with the very moderate pressure of 30,810 pounds to the inch. Now these velocities are considerably higher, and the corresponding energies greater, than those of the government 6-inch guns either in the army or navy, the latter 50-caliber piece having a service velocity of 2,700 to 2,800 foot seconds with pressures of not less than 18 tons to the inch, while the service velocity of the army 6-inch guns is to be lowered, we believe, to 2,600 feet per second, with a view to reducing powder pressures and so prolonging their life.

In view of the promising results obtained in the earlier rounds of these guns, we would suggest to the artillerists that the solution of the problem of erosion may, after all, be found in the direction of large powder chambers and greater length of gun, combined with a high average pressure along the bore and low maximum pressure in the powder chamber. It is our belief that a 55-caliber, 6-inch gun, using a heavy charge of slow-burning powder specially designed for it, in a powder chamber of capacity equal to those of the Crozier and Brown guns, and with its projectiles double-banded, would be able to maintain a service velocity of 3,000 feet per second for a sufficient number of rounds to give the gun a satisfactory term of life, before re-lining became necessary—if, indeed, the application of the above principle did not entirely cure the evil.

VALUE OF RARE EARTHS FOR ELECTRICAL PURPOSES.

In the improvements of electrical illuminants the demand for rare earths has greatly stimulated mining for them in different parts of the country. When carbon was employed almost exclusively in arc and incandescent lamps practically little value was attached to many of the long list of rare earths which in the past few years have become quite common in the electrical industry. The discovery that the rare earth oxides possessed unusually desirable properties for use as illuminants gave a new impetus to laboratory experiments, and the demand for these oxides increased rapidly under the development of the Nernst lamp, the incandescent gas mantles and the tantalum lamp.

Welsbach first used thoria and ceria for producing gas mantles, and this suggested the possibility of securing materials for electrical illuminants that would prove equal to, if not superior to, the carbon filaments. While carbon is practically infusible, it nevertheless slowly vaporizes at the high temperature maintained in the incandescent lamp, so that after being used from 400 to 600 hours it is necessary to renew it.

In tests with the rare earths it was found that they were more fusible than carbon, but their vaporizing properties were in some cases much less pronounced. It is this slower vaporizing quality of the rare earth oxides that makes the Welsbach mantle and the Nernst lamp possible. Connected with this quality of slow vaporizing at high temperature is the equally important one that many of the oxides conducted electricity at ordinary temperatures. Others only conducted electricity at very high temperatures, but were found to be very refractory. By mixing several different kinds of the oxides and baking them in the form of filaments a higher fusing point was obtained and greater electrical conductivity. The possible combinations of these oxides open a wide field for future experiment.

Thus, in the Nernst lamp a combination of 85 per cent zirconium oxide and 15 per cent of yttria earths is used; but yttria itself is a mixture of several oxides found in certain minerals. The early gas mantles were composed largely of zirconia, but these have been improved by combining other rare earths to increase the refractory nature of the glowers. The improvements are due entirely to a study and a long series of experiments with the different earths.

The value of a commercial glower depends upon its efficiency and its ability to operate at a high temperature for a considerable length of time. Thus, the Nernst glowers operate at a temperature of about 2,300 deg. C., and at about twice the efficiency of a carbon incandescent lamp. The ordinary life of these glowers averages 800 hours when the depreciation of the candle-power is sufficient to destroy its usefulness. Both the Nernst and carbon incandescent lamps have their period of usefulness rated by the number of hours required to decrease the candle-power by 20 per cent of the initial light. Similarly the value of the tantalum filament of the tantalum lamp is dependent upon the relative time required to depreciate its conductive and glower properties when used under high temperatures.

The experiments with the rare earths to secure higher illuminating efficiency are further emphasized by the difference in the quality of the oxides obtained from various parts of the world. Until comparatively recently most of the rare earths for electrical purposes were obtained from Europe, but deposits have been found in this country which possess superior qualities to those imported. Some of the best zirconium silicate is mined in Henderson County, North Carolina, and deposits have been discovered in other States within the past few years. The North Carolina deposit contains upward of 67 per cent of zirconium as oxide. It is found in a ball mill mixed with about twice its weight of crude acid potassium fluoride. The recovery of the ore by fusing in a graphite crucible and dissolving it in chemicals is not a very intricate or costly process. The zirconium thus obtained is reasonably pure. Test glowers from hundreds of lots of zirconia demonstrate that the best oxides can be obtained and purified from the American mines. Absolutely pure zirconia is not demanded, and the slight traces of silica left in the American product tend to improve the efficiency of the lamps.

In Llano County, Texas, considerable quantities of gadolinite in crystalline form associated with yttrialite, crytolite, fergusonite, rowlanite, allanite, and other minerals are found. Not many years ago the minerals gadolinite and yttrialite were obtained entirely from Norway and Sweden, and their cost made even laboratory practice with them rather expensive. The deposits in Texas are supposed to be of volcanic origin, and they are radio-active and contain a certain amount of helium gas.

Tests of these products in Texas show that the gadolinite is composed chiefly of 40 to 45 per cent of yttria earths, 23 per cent of silica, 13 per cent iron as oxide, and 9 to 12 per cent of beryllia. The yttrialite contains from 42 to 47 per cent of yttria earths, 30 per cent of silica, and 5 to 6 per cent of ceria, didymia, and lantham, with slight traces of urania. The fergusonite contains roughly from 30 to 42 per cent of yttria earths, 33 to 46 per cent of niobia; and rowlanite from 46 to 62 per cent yttria earths, 26 per cent of silica, and traces of iron and magnesia. Allanite has large percentages of iron, calcia, and alumina, with only traces of yttria and 26 per cent of ceria and didymia.

These natural combinations of the rare earths in the Texas deposits make it reasonably simple to recover what is desired, and the various ingredients are separated and used for different purposes. The recombining of the different earths for illuminant filaments is a work that possesses great fascination for the experimenter. So far it has been demonstrated that the yttria earths containing the greatest atomic weights produce the most satisfactory glowers. The relative value of the ores obtained from Norway and Sweden and those mined in Texas can be judged by the fact that the former has as low as 90 to 92 atomic weight compared to 115 for the Texas yttrialite, 107 for rowlanite, 163 for the fergusonite, and 100 for gadolinite.

The question of the actual amount of these deposits in this country is one that has not yet been definitely settled. Reports of equally valuable deposits in Colorado and other Western States have been made, but whether the quality of the rare earths is as good as those found in Texas is open to doubt. The actual demand for the ores has not in the past been sufficient to make them of great commercial value, but with their extensive use in electrical illumination important new industries promise to be built up. So long as their use was confined chiefly to laboratory practice and experiment there was little chance of their commercial development on a large scale.

The manipulation of the different oxides to secure better results suggests great possibilities in the field of experiment. The remarkable development of tantalum metal in the past few years is an indication of the advances made along this line. Until a few years ago tantalum metal was not known to possess the properties which make it of such service in electric illuminants. In some of the laboratories experimental lamps have been made with electrodes composed entirely of the rare earth oxides. From these experiments new filaments may be devised in time which will greatly increase the efficiency of the lamps and prolong their days of usefulness without renewals. In arc lighting the introduction of boron and tantalum in different proportions and forms is being pursued with tireless energy. In Europe the experiments with rare earths in electric arcs have been more energetically pursued than in this country, but with the discovery of new and rich deposits of these materials in this country it is not unlikely that considerable experimental work will be carried on in private laboratories and manufacturing shops. There is unquestionably a great future for further important developments in electric illumination in this direction.

PERHYDRASE MILK—A NEW STERILIZED MILK.

The problem of freeing milk from germs and yet retaining all its nourishing properties has probably been solved by Drs. Roemer and Much, both of whom have been associated with Prof. Behring in his bacteriological work. The process consists in the use of peroxide of hydrogen under conditions which kill the germs. To each liter of milk is added two to four drops of a ferment obtained from beef liver from which the blood has been expressed. This ferment, which contains minute particles of albumen, destroys the unpleasant taste given to the milk by the peroxide of hydrogen. To the forty grammes of albumen contained in one liter of milk under normal conditions there are, therefore, added minute quantities of homologous albumen.

"Perhydrase milk," as it is called, does not materially differ from raw milk. It can, however, be kept for a long period without deteriorating. Samples of the milk which were placed in an incubator for seven weeks remained sterile. Experiments made by mixing