about 205. Remembering that the atomic weight of radium is uncertain to at least a unit, and that, if anything, the atomic weight of helium is likely to be less than four, it is not impossible that lead (207) may well be radium G. This is as much as can be said for the moment.

BLUE LIGHT AND ELECTRICITY AS ANÆSTHETICS.

A few months ago attention was called in these columns to a method of producing anæsthesia by means of blue light. It was not claimed for the method that it would answer for any but minor surgical operations; still it seemed sufficiently promising for the painless extraction of teeth. The patient was submerged, as it were, in a bath of blue light. The rays, it was thought, influenced the brain through the optic nerve. Perhaps there was also something of hypnosis in this supposed effect.

Dr. J. C. Watkins, a southern dentist, has conducted some experiments which have certainly added much to a true conception of the cause and effect of blue-light anæsthesia. He used the blue light, not for the extraction of teeth, but for "the reduction of swelling and the alleviation of pain." The system that he advocates is simple. It consists merely in applying the blue rays directly to the part affected.

The apparatus which he employs comprises a sixteen-candle-power blue electric-light globe arranged in a funnel-shaped tin shield which at its mouth is about four inches in diameter. This is extended about four inches, and has at its end a ground blue glass and convex lens. The ground blue glass is used to disseminate the blue rays so that the patient may not know the simplicity of the apparatus; no especial virtue is to be attributed to the lens.

A clinical history of cases which he has treated and which he has enumerated and discussed in the Dental Cosmos more than bear out the doctor's claims for the anæsthetic effect of blue rays.

Still another method of producing anæsthesia is that of Prof. Leduc, whose studies with electric currents of low tension have attracted not a little attention. Dr. Louise G. Robinovitch, of New York, one of his assistants, has continued his work and has recently published the results of her investigations. Thus far chiefly animals have been used for experimentation. With 110 interruptions per second, the animal receiving about 1.3 milliamperes, at 5½ volts, complete anæsthesia results. The preliminary contractions seem to be painless. General and special sensibility and consciousness are soon abolished. When fully under the influence of the current, the animal may be picked up by a fold of its skin, turned from side to side, pinched or pricked without provoking any reaction on its part. Hearing and sight are lost. The animal remains limp and senseless so long as the current is kept up, sleep being immediately interrupted by the opening of the circuit. Once awake, the animal shows no untoward symptoms. A large number of these experiments made in Prof. Leduc's laboratory were accompanied by no objectionable manifestations. In some instances the same animal has been subjected to the experiment several times during the same day, without causing the animal any apparent discomfort or fatigue. Prof. Leduc, Prof. Rouxeau, and Dr. Robinovitch subjected one animal to electric sleep during a period of three hours and ten minutes, without having caused it any discomfort. Prof. Leduc has himself performed the experiment on dogs over one hundred times and on rabbits a good many times, obtaining good results in all the cases. He has studied the current in its various phases, and cautions against its application for the purpose in question with a lower frequency of interruptions. A higher frequency is also useless.

Prof. Leduc submitted himself to experiment, and the description he gives of his sensations during this sleep is interesting:

"Although disagreeable, one can readily stand the sensation produced by the excitation of the superficial nerves, as this sensation gradually dies away in the same manner as does the sensation produced by a continuous current; after reaching its maximum, the disagreeable sensation commences to wane, although the potential is still increasing. The face is red, and slight contractions are visible upon it, as well as on the neck and even the forearms; there are also some fibrillary twitchings, and tingling sensations extend to the hands and tips of the fingers as well as to the feet and toes. As regards cerebral inhibition, the center of speech is first to be affected, then the motor centers become completely inhibited. There is impossibility of reaction even to the most painful excitations. At this stage it becomes impossible to communicate with the experimenter. Without being in a condition of complete resolution the limbs present no rigidity. Some groans are emitted, but not on account of any pain; excitation of the laryngeal muscles seem to cause the sound. The pulse remains unaltered, but respiration is somewhat disturbed. The current was gradually increased to 35 volts, and its intensity in the interrupted circuit was 4 milliamperes. When the maximum of the current was turned on I could still hear, as if in a dream, what was being said by those near me. I was conscious of my powerlessness to communicate with my colleagues. I still retained consciousness of contact, pinching and pricking in the forearm, but the sensations were stunted, like those in a limb that is 'asleep.' The most painful impression was that of following the gradual dissociation and successive disappearance of the faculties. This impression was similar to that experienced in a nightmare, in which one feels powerless to cry out for help or to run away when facing great danger."

Prof. Leduc regrets very much that his colleagues did not increase the current sufficiently for complete suppression of sensibility and inhibition of consciousness. The experiment was performed twice, lasting twenty minutes each time. In both instances awakening was spontaneous, with a feeling of well-being.

As the experiment on Prof. Leduc was not complete, it may be of interest to remark that anæsthesia is absolute when a current of sufficient potential is used. Dr. Robinovitch experienced herself complete anæsthesia of the forearm, hand and fingers from a local application on the forearm of this current, 25 volts being used. Anæsthesia was perfect.

THE ADVANTAGES OF PRODUCER GAS FOR LARGE POWER PLANTS.

When the theoretical and practical efficiency of the internal-combustion engine is considered (an efficiency from two to five times greater than that of the average externally fired heat engine) and when we take into account the fact that the smallest gas engines have a thermal efficiency from 20 to 24 per cent, while the largest steam engine, with all the modern refinements known to the art, turns into work only 12 per cent of the heat supplied at the furnace under normal conditions, one wonders why we are not using gas engines in our large power plants. To be sure the first cost of a large producer-gas engine plant is not far from that of a steam plant; for the first cost of a generator, coal-handling apparatus, piping, scrubbers, cleaners, compressor, and engines is about equal to that of boilers, engines, pumps, condensers, chimney piping, and all accessories. On the other hand there are inestimable advantages in favor of the producer-gas engine which should commend it to the notice of the modern engineer. In an excellent paper read by Mr. C. E. Sargent before the Western Society of Engineers these advantages are admirably discussed, and on his paper we base these observations.

Largely because the pressures maintained in gas-engine installations are not as great as those in boiler plants, the depreciation from internal strains and corrosion should be considerably less. Gas engines wear out no more quickly nor are they more exacting in the way of repairs than steam engines. On the other hand, gas producers are long-lived. Mr. Sargent instances one installation of two 200-horse-power producers which have been continuously driven for seven years and in one of which the fire has never been drawn. One can hardly imagine the condition of a boiler after such continuous work.

The waste heat of a producer, amounting to about 70 per cent of the heat supplied, can be used for heating very much in the same way as exhaust steam from the steam engine. It must be remembered, however, that a higher temperature can be maintained with exhaust gases than with exhaust steam. Furthermore, the gas holder of the gas plant provides for the peak of the load, even though the producer is run at a uniform rate. With sufficient capacity of holder the gas producer may be run with a uniform output for every hour out of the twenty-four although the engine load may very widely. Add to this the fact that there are no losses from radiation or leakage as would exist in a boiler plant under pressure, and we have a rather complete picture of the efficiency of a large producer-gas plant.

VALUE OF COMMERCIAL CULTURES FOR LEGUMES.

Great interest was aroused among agriculturists in this country by the newly-developed inoculation process of supplying bacteria for the promotion of the better growth and nitrogen gathering powers of legumes. The investigations undertaken by the Department of Agriculture were apparently crowned with success and much was expected from this method in the betterment of agricultural conditions. From a Bulletin lately issued by the New York Agricultural Experiment Station, at Geneva, N. Y., it appears, however, that these commercial cultures for legumes are exceedingly unreliable. The Station undertook a series of exhaustive tests in consequence of the numerous inquiries which were received as to the quality of the commercial packages of the culture, and the results were anything but favorable; not only so far as the commercial product was concerned, but in the case, as well, of the package received from the government. These extended and careful tests in five different laboratories, using many packages of the cotton prepared at different times, kept under favorable conditions, all comparatively fresh, and used in accordance with the directions, appeared to prove that such packages are worthless for practical inoculation. This must not be ascribed to dishonesty on the part of the company preparing the cotton, for, as mentioned above, the Department package tested gave no better growth than the commercial specimens. The trouble lies in the method itself. The legume inoculating bacteria, dried on cotton and exposed for a limited time to the ordinary changes of temperature and humidity, die or lose vitality so that they do not develop satisfactorily when used as indicated by the directions.

That such cultures rapidly deteriorate on cotton under laboratory conditions was proven by preparing fresh, vigorous cultures, saturating cotton with the bacteria-charged liquid, drying the cotton, and testing portions of it from time to time. In the earlier examinations, within a week or so after drying, a few colonies would develop, but generally the culture plates were found practically sterile at the end of seven days.

These experiments, with their surprising and disappointing results, do not condemn inoculation. They merely show how and why many recent attempts to inoculate legumes have failed. Inoculation as such has not come into question at all; as it cannot be considered inoculation unless living and vigorous bacteria are brought into contact with the plant to be inoculated. The use of the dried cotton cultures has been in most cases only an unsuccessful attempt to inoculate.

The principle of inoculation remains unchanged. There can be no doubt that the introduction of bacteria where lacking and under proper conditions for their growth will benefit legumes.

But it is certain that the commercial packages of cotton as distributed in 1905 are not reliable agencies to secure such inoculation.

SCIENCE NOTES.

In a paper presented to the Académie des Sciences, Messrs. Guntz and Roederer mention their researches upon the preparation and properties of the metal strontium. The properties of this metal are but little known up to the present, and seem to differ according to the authors who treat the question. Therefore, it seemed of interest to take up the study of this body. The authors prepare it by the method which they already used in preparing barium. At first the hydride of strontium is formed, which is free from mercury by the continued action of hydrogen upon a strontium amalgam. When placed in a vacuum produced by the mercury pump and heated to 1,000 deg. C. this body is decomposed and we are able to condense the vapor of strontium on a cooled steel tube without any difficulty. The authors mention some of the properties of the metal which they have observed. Their product contained 99.43 per cent of the pure metal. It is of a silver white color and is crystalline in form, but it tarnishes almost instantly when in contact with the air. It melts at about 800 deg. C. and volatilizes at a higher temperature. Dry carbonic acid gas has no action upon it in the cold. At a red heat this gas is absorbed with formation of a carbide and also of strontia. Ether and benzine have no effect on the metal, but absolute alcohol dissolves it easily and hydrogen is given off. Water is also decomposed by the metal, forming strontia, which is dissolved. In the test which they made to find the heat caused by the oxidation of the metal, they find that this lies between the figures for calcium and barium, as the chemical analogies lead us to suppose.

Henryk Arctowski, a member of the Belgian Antarctic expedition, is planning to go to the South Pole in an automobile. He declares that one may go by ship to the lower end of Ross Sea, at 78 degrees latitude, to the foot of Mount Erebus and Mount Terror, proceeding thence to the point already reached by Scott. This explorer was forced to proceed on foot for five months. He could have continued on his way over the icy plain, but did not have sufficient provisions, and was compelled to retrace his steps. It is now a question, therefore, of finding out how one can accomplish this journey in an automobile, and advance even farther. The distance from Mounts Erebus and Terror to the South Pole is 1,296 kilometers (about 805 miles). Mr. Arctowski believes that he can accomplish this distance in three trips of 432 kilometers (about 268 miles) each. A first automobile will depart loaded with provisions, and will arrive at the first station. A second will be dispatched to restock the first with gasoline, and will return to the point of departure. A third automobile, making two trips, will restock the first automobile at the second station, permitting it to proceed to the actual pole. Returning, one automobile will be abandoned at the pole, and another on the way, it being impossible to do otherwise. They will cover 10 kilometers (6.2 miles) an hour, or 20 at the most, and will be specially constructed, after experimenting on the Alpine glaciers, for instance on the Aletch Glacier in Switzerland. The expedition will depart in August, 1907, for the Antarctic regions.