DEFLOCCULATED GRAPHITE AND THE "ACHESON EFFECT."

BY ORRIN E. DUNLAP.

Deflocculated graphite is the latest invention of E. G. Acheson, the discoverer of the processes for making carborundum and artificial or manufactured graphite. In the deflocculated condition produced by Mr. Acheson, graphite has a condition of fineness far beyond that attainable by mechanical means. In fact, its condition resembles, if not wholly approaches, the molecular state. The "effect," for such it must be termed, is produced with water and a comparatively small quantity of gallotannic acid, and when thus treated the unctuous graphite remains suspended in the water, showing not the slightest disposition to settle. The black liquid passes with ease through the finest filter paper. Severe tests have demonstrated that it is an admirable lubricant. There is every reason to believe that deflocculated graphite with or without oil will become a popular agent for all classes of lubrication, for, strange as it may seem, deflocculated graphite possesses the remarkable power of preventing rust or corrosion of iron or steel.

It was in March, 1891, while Mr. Acheson was experimenting in Monongahela City, Pa., that he discovered carborundum. Sixteen years ago he carried about in a small vial in his vest pocket all the carborundum he had been able to produce in two months. With this vial in his pocket, he hurried off to New York city to interest diamond cutters in his new product. To them he sold the contents of that vial at seventy cents a carat, receiving $60 for all there was in the world. With this money he bought a microscope with which to study the structure of the carborundum crystals. Looking from his office window to-day, Mr. Acheson has a splendid view of the carborundum plant, and in the evening he notes that between 400 and 500 men leave it for their homes after passing the day in making carborundum and putting it in shape for sale throughout the world. It was in 1895 that commercial operations were begun in Niagara Falls, using 1,000 electrical horse-power, while to-day the works are equipped for 5,000 horse-power.

Mr. Acheson's vest pocket carries another little vial to-day, and in it is deflocculated graphite. Having given the world the hardest known abrasive, and thus advanced the art of abrasion, he has solved the problem of how to reduce the cost of lubrication.

Before the latter part of the sixties, petroleum oils were unknown, commercially, animal oils having been used for lubrication entirely. In the forty years that have passed, the world has seen a change from animal oils to mineral oils, and witnessed the growth and development of the wealthiest corporation in the world. To-day it is stated that the major part of the business of the Standard Oil Company is the manufacture not of illuminating oils, but of lubricating oils. The commerce and manufacturing of the world is guided by wheels operating in bearings, the important problem being to keep things running smoothly. No wars, no business depressions cause a cessation of the demand for lubricants.

It has been known for years that graphite is an excellent lubricating body, both in a dry state, and particularly when associated with oil, fats, or water. Strenuous efforts, extending over a long time, have been made to suspend graphite in a liquid to be used as a lubricant, but all these efforts were unsuccessful. It is a well-recognized fact among scientific men that plain water has many advantages as a lubricant if it had sufficient body to withstand the pressures brought to bear and to which lubricants are subjected. Its very high specific heat would be of great advantage to keep down the temperatures of bearings, while its low viscosity would reduce friction, but unfortunately it has not sufficient body to withstand the pressure of an ordinary bearing. It also has the fatal quality of rusting and corroding metals, thus making it absolutely worthless as a lubricant.

The "effect" which Mr. Acheson has discovered makes it possible not only to reduce graphite practically to the molecular state, and to cause it to remain suspended in water for an indefinite period of time, but also to prevent iron and steel from rusting or corroding while associated with water, thus rendering of advantage the high specific heat and low viscosity of water.

In 1901 Mr. Acheson engaged in a series of experiments having as their object the production of crucibles from artificial graphite. This led him to a study of clays, and he learned that American manufacturers of graphite crucibles import from Germany the clay used by them as a binder of the graphite entering into the crucibles; also that the German clays are more plastic and have a greater tensile strength than American clays of very similar chemical constitution, while residual clays—those found at or near the point at which the parent feldspathic rock was decomposed—are not in any sense as plastic or as strong as the same clays are when found as sedimentary clays at a distance from their place of origin. Chemical analysis failed to account for these decided differences.

Under these conditions Mr. Acheson reasoned that the greater plasticity and tensile strength were developed during the period of transportation from the place of their formation to their final bed, thinking possibly it might be due to the presence of vegetable extractives in the waters which carried them. He made several experiments on clay with vegetable extracts, tannin being one of them, and found a moderately plastic, weak clay, when treated with a dilute solution of gallotannic acid or extract of straw, was increased in plasticity. Familiar with the record of how the Egyptians made the Children of Israel use straw in the making of bricks, and believing it was used not for any benefits derivable from the weak fibers, but for the extract, he calls clay so treated Egyptianized clay.

In 1906 Mr. Acheson discovered a process of producing a fine, pure, unctuous graphite. He undertook to work out the details of its application as a lubricant. In the dry form, or mixed with grease or oil, it was easy to handle, but he wished it to enter the entire field of lubrication as occupied by oil. In his efforts to suspend it in oil, he met the same troubles encountered by his predecessors in this line of work. It would quickly settle out of the oil. His unctuous graphite was just plain, simple graphite, and obeyed the same laws covering the natural product.

This was the condition of things in the latter part of 1906, when the thought occurred to him that tannin might have the same effect on graphite as it did on clay. He tried it with satisfactory results. The writer has seen most interesting experiments made with unctuous graphite of Mr. Acheson's manufacture, a graphite which may be termed disintegrated unctuous graphite.

To one sample of this graphite plain water was added, and after rubbing it in a mortar it was poured into a test tube.

To another sample of the graphite and water and a little gallotannic acid were added also a few drops of ammonia, this last being not absolutely necessary, but having been found to improve the result with some waters. This second mixture was rubbed in the mortar as in the first case, and then was poured into a second test tube. Both tubes and their contents were thoroughly shaken, and simultaneously placed in a rack to settle.

When about two minutes had elapsed after the shaking, it was found that the graphite in the plain water had very completely separated from the water, not being miscible therewith, while the mixture of water, graphite, tannin, and ammonia remained as black as when originally shaken up. The graphite was thoroughly suspended, and showed no disposition to settle or separate.

Next from a bottle containing a quantity of graphite, water, tannin, and ammonia, which had been mixed some weeks, as stated, a quantity was poured into a glass funnel containing one of the finest filter papers made in America. The deflocculated graphite ran through the fine filter paper and collected as black as ever in the tube below, apparently unchanged. Its passage through the paper was remarkably rapid, leaving no doubt but that it was thoroughly mixed; and in order to demonstrate that the black liquid was a mixture of water and a solid body—graphite—a few drops of hydrochloric acid were introduced into the test tube containing the mixture. This was slightly warmed over a spirit flame, causing the suspended graphite to flocculate, so that when the liquid was again poured into a filter paper, the water ran through clear, the graphite remaining on the paper. A small quantity of this graphite was removed from the filter paper and rubbed on another paper, where it was dried. Then a brisk rubbing with the finger brought out the full luster of the graphite. Mr. Acheson has obtained this effect with amorphous bodies generally, alumina, lampblack, clay, graphite, and siloxicon, the only exception being magnesia, which needs further tests.

These were the conditions surrounding Mr. Acheson's experiments until the latter part of April. His success in deflocculating graphite and causing it to remain suspended in water was most gratifying, not only to himself, but to others who appreciated the wonderful possibilities of this magnificent new lubricant. However, Mr. Acheson realized that the world at large has been educated to the use of oil as a lubricant, and that it might be difficult to re-educate them to the use of water and graphite for a similar purpose until they better understood what he had accomplished. It was with this conviction that he undertook to solve the problem of replacing the water used as a conveyor of the deflocculated graphite with petroleum.

His first experiment, and probably the simplest and most rational, was to diminish the quantity of water by evaporation, leaving the graphite in a dry state, to be rubbed up later in oil. While this method produced what seemed to be an ideal result, it was soon discovered that in a comparatively short time the graphite had settled out of the oil, having lost its deflocculated condition and returned to its original flocculated state. Consequently, it was not in condition to remain suspended in oil, nor indeed was it possible again to suspend it in water, a fact strange to record.

Notwithstanding this decided failure, and the apparently insurmountable difficulty associated with the problem, the desired result was eventually accomplished. The writer has witnessed the suspension of deflocculated graphite in water, has seen the water removed, and the deflocculated graphite suspended in oil and passed through the finest filter paper, remaining suspended thereafter in a most remarkable manner. In these circumstances, Mr. Acheson now feels assured that with his disintegrated unctuous graphite, which is guaranteed to contain less than one per cent impurity, and which can be mixed with oils or grease as may be desired for all specific uses; with his deflocculated graphite in water for the lubrication of steam-engine cylinders and other places and parts where the introduction of oils is objectionable; and with his deflocculated graphite in oil, the quantity carried by the oil to be varied to suit requirements of the most difficult lubrication, he can meet any demand for a lubricant where oil is preferable and evaporation of his water lubricant might be objectionable. It should be understood in this connection that the very lightest and thinnest of oils, when used in conjunction with deflocculated graphite, can be used in the place of the heavy and expensive lubricating oils of the present day, while the lasting qualities of these graphite lubricants will be greater by far than the oil lubricants heretofore used.

Automobile Notes.

The first of the great automobile races of the year—the Targa Florio—was run off on the 20th ultimo over a mountainous and rather rough course 450 kilometers (279.45 miles) in length on the island of Sicily. The race was for touring cars with racing bodies. It was won by Nazzaro on a 35-horse-power Fiat, with Lancia on a car of the same make, second; Fabry, on an Itala, third, and Duray, on a De Dietrich, fourth. Nazzaro beat Lancia by 12 minutes, and won not only the cup but a cash prize of $3,000 as well. His time was 8 hours and 17 minutes, corresponding to an average speed of 34 miles an hour. This was an excellent performance considering the roughness of the course.

The great English race for touring cars—the Tourist Trophy race—will be held for the third time on the Isle of Man on May 28. In this race, as heretofore, each car will be allowed a certain quantity of fuel with which to cover the course, the winner being the car that covers it the quickest on this allowance. Twenty-five miles on a British gallon is the distance which is required to be covered. Nearly all the great road races held abroad this year will be based on a limited fuel consumption or cylinder capacity.

In this connection it should be mentioned that plans are being made for a similar touring car race to be held on the new motor parkway on Long Island after the Vanderbilt cup race. It is proposed to limit the cars to a certain cylinder capacity. In addition to this, it would make the race much more interesting if they were also allowed a limited supply of fuel.

The chief touring event in America this year is to be conducted by the American Automobile Association in July. This will be the third annual contest for the Glidden trophy and will start from Cleveland on July 10. The route will be through Detroit and Lansing, Mich., to Chicago; thence south and east to Indianapolis, Columbus, Cincinnati, Pittsburg, Harrisburg, Philadelphia, and New York. It is proposed to have only noon and night controls, with two minutes leeway; also to require the cars to make a good average speed behind a pacemaker and not to allow them to use any spare parts except those they carry with them. Besides the Glidden trophy for touring cars (which will this year be awarded to the club which makes the best showing) a trophy has been offered for runabouts and will be awarded to the owner who makes the best performance with this style of car.

Oxford Honors for Prof. A. G. Bell.

Prof. Alexander Graham Bell has received the honorary degree of Doctor of Science from Oxford University, in recognition of his efforts to teach the deaf and dumb to speak, as well as for his invention of the telephone. The presentation was made on May 2 last by the dean of the faculty of science, Prof. A. E. H. Love.

The first American gas engine patent, No. 3,597, issued May 25, 1844, was granted to Stuart Perry, Newport, N. Y., for his two-cycle, double-acting, air-cooled gas engine. Perry proposed to inclose the cylinder and its immediate appendages in a case, through which cold air could be blown by means of a rotary fan or other blowing apparatus. Mr. Hugh Dolnar, in an article in the American Machinist, claims that Perry not only was the original inventor of both air and water cooling of gas-engine cylinders, but also was the first to devise a hot-tube ignition system, which was reinvented and patented many years later by Gottlieb Daimler.