4. It appears from 3 that if there is any frictional hold between the plates, it acts only over those portions in the immediate neighborhood of the rivets. All the experiments tend to show that friction does not play an imporant part, but further experiments are necessary on this point.

5. Experiments made on a number of specimens having a single line of rivets and loaded in tension give results in close agreement with the theoretical considerations. They also show that the longitudinal stresses in a portion of the cover plate between two consecutive rivets are a minimum along the line of rivets, rising to a maximum at the edges of the plates.

6. The experiments show that the value of K for a joint having a given ratio of width of cover plate to rivet pitch and a given number of rivets varies approximately directly as the load and inversely as the area of the rivets. An empirical rule is given for its value in joints similar to the experimental specimens, but a more general rule cannot be given until further experiments have been made. A theoretical estimate is made of the value of K for a rivet acting in shear, and the result is shown to be within the range of the experimental values.

7. Both the experimental results and the theoretical deductions show that: (a) in a double-cover butt joint having a single line of rivets, the two end rivets and the two rivets on each side of the junction of the middle plates take by far the greater part of the load at all loads within that causing permanent deformation of the plates or rivets, the actual proportion decreasing slowly as the load increases; (b) if, in such joints, the total area of cross-section of the cover plates is equal to that of the middle plates, these four rivets take equal loads, but if it is greater the end rivets take greater loads than the others, the difference increasing as the area of the cross-section of the cover plates increases; (c) if two plates of uniform width and equal thickness are connected by a single line of rivets to opposite sides of a gusset plate of uniform width, the first and last rivets take the greater part of the load, but if the gusset plate increases in width from the first to the last rivets, the partition of load is more uniform.

WORLD'S OUTPUT OF GRAPHITE.

Interest in graphite at present is widespread. According to the Canadian Mining Institute Bulletin the two principal forms in which the mineral is found are amorphous and crystalline, the former being very common. The world's production statistics (in tons) for 1912, the latest available, are as follows: Ceylon, 36,660; Canada, 2,060; South Africa, 42; Austria, 50,017; Madagascar, 3,011 United States, 3,835; Mexico, 3,158; Korea and Japan, 8,363; Germany, 13,814; Italy, 14,517; Sweden, 87; Norway, 285; France, 661; total, 136,510.

PAVING EQUIPMENT FOR CUBA.

One of the largest single shipments of paving equipment on record is that just made to Messrs. Torrance and Portal, of Havana, Cuba, who have secured extensive paving contracts for Havana and Cienfuegos.

The shipment made by the Iroquois Works of the Barber Asphalt Paving Company consisted of six cars routed by way of Key West, Florida, carrying two three-unit asphalt plants, two 2,000-gallon and one 1,000-gallon steam-heated melting kettles, four tandem rollers, two portable boilers and engines, fire wagons, paving tools, etc.

Contracts already secured by the Havana firm for paving in which Trinidad lake asphalt will be used total about 400,000 square yards. One of the Iroquois plants is to be located at Havana and the other at Cienfuegos.

BITUMINOUS SAND-GROUT PAVEMENT.

J. A. BRODIE, city engineer of Liverpool, Eng., has developed a type of pavement which has not yet been constructed in this country, but which is most interesting from the standpoint of a low-first-cost country or interurban road. Mr. Brodie calls his pavement "pitch macadam," but it has been referred to by most engineers who have reported upon it as a "bituminous sand-grout pavement." He has laid forty-one miles of it in Liverpool, and some of his roads have been in service for over fourteen years and are still in good condition.

Col. Wm. D. Sohier, chairman of the Massachusetts Highway Commission, has laid three experimental stretches of road following Mr. Brodie's ideas, although altering his specification somewhat in order better to suit local conditions. About 300 ft. of these experimental roads was laid with asphalt, the remainder being laid with tar. These Massachusetts roads are less than three years old, so that it is a little early to predict their success, but Col. Sohier says that there is no question in his own mind but that the bituminous sand-grout pavement will be stronger and wear longer than any other bituminous penetration or mixed road.

In all, 381 miles, or 44,532 square yards, of this pavement have been laid in Massachusetts. The engineers in charge of the work report that its present condition is excellent, and that there have been practically no repairs. All three sections are on main routes; motor vehicle traffic being probably 90 per cent. of the total, with considerable heavy motor trucking and teaming.

Owing to the success of these roads in Liverpool, there is no doubt but that some enterprising municipality or contractor will experiment with them in Canada in the near future. The following is a résumé of Mr. Brodie's specifications:—

The Brodie Specification.—"Upon a 10-inch hand-pitched foundation, laid and consolidated in accordance with the specification for water-bound macadam, a layer of dry macadam of 2½-inch gauge stones, similar in quality to that used for water-bound macadam, shall be spread evenly to a depth of about 3½ inches (before consolidation). This layer, after being rolled with a light steam roller, shall be grouted with a hot mixture of pitch and creosote oil prepared in accordance with the specification below, and again rolled while hot until the mass is thoroughly consolidated. A second layer of similar macadam of 1½-inch gauge stones 3 inches deep shall then be laid, preferably while the lower layer is still hot. After being rolled dry it shall be grouted in a similar manner with the pitch mixture, and again rolled until the whole is consolidated. The surface shall be finished off with a sprinkling of dry granite chippings. The road shall be laid to an approximately circular camber, with a cross-fall from crown to channel of 1 in 48.

"The pitch mixture used for grouting shall consist of coal tar pitch and creosote oil supplied to the specifications given below, and boiled together in a tank in the proportions of approximately 70 gallons of oil to one ton of pitch, a temperature of from 250° to 300° F. being attained. The proper consistency shall be obtained by applying the following rough tests, *viz.*:—

"A small sample of the mixture when cooled in water to 60° F. shall stretch at least 3 feet without breaking, the threads pulling out very fine. It shall also, when doubled into length of about one foot, bear hitting hard on a hard surface without showing any signs of cracking.