mean tractive power of an engine having cylinders 17 in. diameter by 22 in. stroke, and driving wheels 60 in. diameter. At the point marked 60 in. on the scale of diameters of driving wheels at the bottom of the diagram, with a pair of dividers measure the length of the ordinate from the base line up to the line marked 17 in. diameter, transfer this to the scale to be used when length of stroke equals 22 in., and read off 106 lb. as the tractive force which will be exerted for every pound mean effective pressure on the piston, or $17^2 \times 22 = 106$. Again, given the diameter of driving

wheels, length of stroke, and tractive power, required the diameter of cylinders: Reduce the tractive to pounds per pound of mean pressure, and taking this value on the scale to be used for the given length of stroke, set it off over the given diameter of wheels, and read off the diameter of cylinders required. Other uses of the diagram will readily suggest themselves to locomotive engineers.—G. R. B., in *The Engineer*.

IMPROVED ROLLERS.

WE illustrate two novel forms of roller, shown at the Royal Agricultural Exhibition, Windsor, by Mr. Edward Pratt, of the Albert Iron Works, Uxbridge. Fig. 1 shows a roller designed for manual power and Fig. 2

FIG. 1.—ROLLER WORKED BY MANUAL POWER.

FIG. 2.—ROLLER WORKED BY HORSE POWER.

IMPROVED ROAD ROLLERS.

one worked by a horse, the peculiar feature of which is that the animal is carried by the machine, instead of drawing it. The construction is sufficiently clear from the illustrations. In the horse power roller the horse stands upon a moving platform, which he continually treads round.

It need hardly be said that the inventor does not intend these machines to supersede steam rollers, but they are applicable in districts where the former would be too expensive, or otherwise unsuitable.

Ordinary rollers drawn by men are of little use, as they cannot be made sufficiently heavy, while those drawn by horses have been found unsatisfactory for reason that the speed is too great, it being essential to efficient action that the motion should be slow. By the use of gearing this end can be attained, while at same time a heavy roller can be propelled with very little power, and taken up steep hills. The speed may be varied to suit the weight carried and the work to be done. The manual power roller can be weighted to 5 tons; that for horse power up to 8 tons, while, exclusive of loose weights, its weight is $4\frac{1}{2}$ tons. This type of roller has the advantage that no footmarks or displacement are caused by the animal's feet, a feature of particular value for lawns and gravel paths.—*Industries*.

DETECTION OF MERCURY IN MINERALS.

By ALEXANDER JOHNSTONE, F.G.S. (London and Paris), Assistant to the Professor of Geology and Mineralogy in the University of Edinburgh.

A STUDENT of modern mineralogy has neither the time nor the inclination to determine qualitatively the metallic and non-metallic elements of the minerals which are continually being brought under his notice by the tedious, if accurate, ordinary wet way analytical methods of the chemist. And yet it is of the utmost importance that he should be able to identify with perfect accuracy the elementary or simple substances of the naturally occurring raw materials of his science—but in the very shortest possible space of time. Accordingly, the most advanced mineralogists of to-day in determining the composition of their ores and vein-stones very properly make use, as much as possible, of the rapid blowpipe methods of testing, such as heating, with and without fluxes and other chemicals, in partially closed tubes, in open tubes, on charcoal, platinum, aluminum, in borax, boracic acid, etc. The whole department of blowpipe analysis, however, has been for the last score of years so sadly neglected, not only in this country and America, but also in Germany and Scandinavia, where its foundation was laid at the end of the last and the beginning of the present cent-

of applying the test and the various preliminaries necessary in every case of blowpipe analysis are briefly detailed below.

The author may here mention that he has very carefully examined all known mercury minerals, and other minerals containing only the slightest trace of that metal, by his process, which in every case has rapidly yielded very satisfactory results.

The first operation in blowpipe analysis consists in heating in a narrow glass tube, closed at one end, first the powdered body *alone*, and afterward, if the previous heating affords certain results, the same with the *addition of a flux*. A substance containing mercury yields, when heated by itself in the closed tube, a sublimate which is either metallic or non-metallic in character. Most compounds of mercury are decomposed by heat alone, and so furnish, when subjected to a certain temperature, the former sublimate; but mercurous chloride and bromide, and mercuric chloride and iodide, and to a certain extent the sulphide also, are volatile without decomposition, and accordingly produce sublimate of non-metallic luster. All compounds of mercury, however, when dry and intimately mixed with threetimes their bulk of ordinary anhydrous fusion mixture ($K_2CO_3 + Na_2CO_3$), yield under the influence of heat metallic mercury, which condenses on the cooler portions of the tube above the assay. This metallic sublimate, when unmixed with other matters (metallic or otherwise), and in large quantity, usually shows distinctly enough its characteristic globules; but when impure and small in amount the globular character is not at all evident, and it may then be quite easily mistaken for arsenic alone, and sometimes, though rarely, for antimony. In the latter case this new process will afford quick and certain means of determination, while in the former it should also prove useful, as trustworthy confirmation. If the substance, then, which is undergoing examination gives with, if not without, the aid of flux a metallic sublimate, pour into the tube two drops of concentrated nitric acid and immediately afterward a single drop of a fairly strong solution of potassium iodide in water. The nitric acid at once splits up the iodide of potassium, and the iodine is liberated in fumes which act on any mercury in the sublimate or in the assay, and *instantly* produce the unique scarlet iodide of mercury, which is largely thrown up against the sides of the tube. The antimony tri-iodide produced in like manner is brownish in color, and becomes yellowish after exposure to the air for some little time. The arsenic tri-iodide is yellow, and this, as in the case of mercury, forms at once; but if the bottom of the tube containing the excess of nitric acid be heated slightly the fumes from that body quickly decompose the iodide, and a spongy dark gray mass of arsenic is driven all around the upper part, at least, of the tube. In the same way the nitric acid quickly decomposes the antimony iodide, while it does not act at all *nearly so rapidly* on the mercuric iodide. The table below shows perhaps more clearly how this test should be applied in the ordinary course of blowpipe analysis.

Table for the Detection of Mercury in Minerals.

- Heat the powdered substance in a small piece of hard glass tubing (say with a $\frac{1}{4}$ inch bore) closed at one end.
 - A metallic sublimate is produced. Proceed further by b.
 - A non-metallic sublimate is formed. Heat a fresh portion of the substance *mixed* with about three times its bulk of fusion mixture. A metallic sublimate forms. Proceed further by b.
 - There is no evidence of the slightest volatilization other than water. No mercury is present in the mineral.
- Pour into the tube containing the metallic sublimate and assay *two* drops of strong nitric acid, then at once *one* drop of potassium iodide solution, and heat the bottom of the tube *a little*. A scarlet mass forms and remains on the sides of the tube. Mercury is present in the body tested.

Detection of Very Minute Quantities of Mercury.

When the mercury occurs in very minute quantities, the metallic sublimate described above may not be perceptible on the sides of the glass tube. In this case, when only the *merest traces* of mercury are looked for in the substance, proceed as follows: Place in the closed tube, as already detailed, the mixture of powdered substance and flux, and introduce on the end of a stout wire a small piece of gold leaf, which should be held just over the surface of the mixture. Now apply heat for a minute or so. Any mercury present will be volatilized, and the vapor will combine with the gold to form a whitish amalgam. Take out the wire with the gold leaf on its end after sufficient heat has been applied to the mixture in the tube. Touch the surface of the leaf which faced the assay with a single drop of concentrated nitric acid, and on the top of this add immediately a drop of potassium iodide solution; the fine scarlet iodide will at once very distinctly appear on the amalgamated surface of the gold leaf if any mercury whatever was present in the body subjected to examination.—*Chemical News*.

DETERMINATION OF THE THICKNESS OF COVER GLASSES ON MOUNTED MICROSCOPE SLIDES.

FIRST some cover glasses of known thickness, as measured by ordinary methods, are taken. With a microscope the upper and lower faces of one of them are observed, which may previously be sprinkled with a little dust. The movements of the micrometric feed screw, which have to be made for this purpose, are noted, a given eyepiece and objective, a fixed length of tube, and also a definite illumination, having been adopted. Dividing the known thickness of the cover glass, expressed by μ , by the number of divisions expressing the movement of the micrometer screw, a coefficient is obtained, which is to be used in subsequent measurements.

When the cover glasses on mounted slides are to be measured, both faces are observed through the microscope, the movement of the micrometer feed screw is observed, and this multiplied by the coefficient already determined will give the thickness in terms of μ of the

ury, that the mineralogist is not unfrequently, against his will and the best interests of his science, forced to fall back, for confirmations at least, on the slow processes of present day analytical chemistry.

With the object in view of completing a working system of quick and certain determinations of elements, on the basis of Berzelius' and Plattner's blowpipe operations, the author has spent much time in carefully investigating the nature and reactions of the known tests, and where these have failed to give, under all circumstances, rapid and satisfactory results, in seeking for new ones to supply their places. As a result of this search for other and better means of identification two new tests have been discovered, one for antimony and the other for mercury.

An account of the former test has already been published in the *Chemical News*, vol. lviii., p. 296, and vol. lix., p. 15; to give a description of the latter is the object of the present communication.

This new method for the detection of mercury, which has been in operation in the author's laboratories for the last six months, depends on the fact that, when a small quantity of iodine in the form of vapor, *newly liberated* from a compound, is allowed to impinge on metallic mercury, it instantly converts it into the characteristic scarlet mercuric iodide. The method