concrete forming jack arches. The floor of the bridge is paved with asphalt, $3\frac{1}{2}$ inches of asphalt being placed on a 6-inch concrete base over a 12-inch layer of cinders and $\frac{1}{4}$ -inch coating of coal tar. The driveway will be 40 feet wide between the curbs when completed, thus affording ample space for carriages outside the two car tracks which will cross the bridge. The sidewalks will be of granolithic construction, 8 feet wide, without obstructions in the shape of trolley or electric light poles along the steel-bound curbs. The parapets are openwork concrete balustrades of classic design.

The 884 balusters are the only parts of the structure not concreted in position. They measure about 23 inches long and 10 inches square, and are cast vertically in cast-iron molds at the rate of twenty daily by a gang of five men. When twenty-four hours old they are taken out of the mold and scrubbed, being afterward immersed in water for one week. In this way a very hard, smooth, gray surface is produced, with sharp corners. This surface closely resembles handsome cut-stone work, and does not crack nor chip. The bottom of the balusters is recessed to engage a projection in the coping to which it is bonded by a vertical steel dowel.

The reinforced concrete handrail is cast in position on top of the balusters. Asbestos felt filling is used in the expansion joints set between the ends of the 22-foot rails and the balustrade piers. In this way crushing and distortion are prevented. Similar means have been employed in other bridges built by the same designer.

The composition of the concrete used is 1 part cement, 2 parts coarse sand, 5 parts of $\frac{1}{4}$ to $\frac{3}{4}$ inch crushed stone; with imbedded flat stones of not less than one-man size placed radially close together. The surface of the concrete is cleaned so as to expose the grit and thus resembles stone in color and texture.

The cost of the construction is a little over a quarter of a million dollars.

THE TRANSIT OF MERCURY.

BY S. A. MITCHELL, PH.D., AND JOHN NEILSON, COLUMBIA UNIVERSITY.

A splendid series of photographs of the transit of Mercury across the face of the sun was obtained by the writers under rather trying circumstances. On the morning of November 14 the sun rose beautifully clear, and through the early morning haze a magnificent group of sunspots that had been on the sun for four or five days were clearly seen with the naked eye. Before a telescope could be pointed at our giant luminary, clouds had gathered and obscured it from view. These grew thicker and thicker, and by 7:30 (the sun rose about 6:45) quite an early winter's snowstorm was raging. While this snow probably delighted the small boy and brought up to his mind visions of coasting, it did not rejoice the hearts of the astronomers to an equal degree, for each minute of the storm meant just so many minutes less for observing the passage of Mercury in front of the sun.

At 8 o'clock the clouds showed no signs of breaking away, and as the transit was scheduled to end at 8:50 A. M., it looked pretty hopeless. But at 8:25 the clouds cleared as quickly as they had gathered, and for the twenty-five minutes remaining there was a perfect blue sky. A series of ten photographs were made.

For the sole purpose of photographing the transit, a temporary observatory had been erected at Larchmont on the shore of Long Island Sound. The instrumental equipment, kindly loaned by the United

States Naval Observatory at Washington, consisted of a celostat, carrying a plane mirror, and a photographic lens five inches in diameter and forty feet in focal length. The light from the sun, after being reflected in a horizontal direction by the mirror, passed through the lens, and was brought to a focus on the photographic plate forty feet distant. Exposures were made by a narrow slit driven quickly across in front of the plate. The whole apparatus thus made a huge camera forty feet in length, which differed from the ordinary camera or telescope in that there was no tube or bellows. Each plate was exposed for the one-thousandth part of a second.

Apparatus With Which the Transit of Mercury Was Photographed.

The plate is in a building 40 feet away.

The developed negatives show the sun in splendid focus a little more than four inches in diameter. Mercury is easily visible as a small spot close to the edge of the sun. Its rapid motion is seen by a comparison of the two photographs taken at 8:27 and 8:48 A. M.

Second in importance to Mercury is the splendid group of spots near the center of the sun. This spot group is over 100,000 miles in diameter, a fact easily tested by comparing with the sun, 866,000 miles in diameter.

The horizontal line was photographed on the nega-

Mercury Nearing the Sun's Edge at 8:27 A. M. Note the Spot Group 100,000 Miles in Extent.

Mercury Showing as a Nick in the Sun's Limb at 8:48 A. M.

THE TRANSIT OF MERCURY.

tive for measuring purposes. The illustration on the left is the sun as it appeared at 8:27. The spot group, dark in the center and shaded toward the edges, is shown in splendid detail. Likewise are to be noted the spots near the edge of the sun. Mercury appears as a small dot on the left-hand side above the horizontal line and near the sun's edge. The second illustration, which is an enlarged view of a portion of the sun, shows Mercury as it is moving off at 8:48. It may be seen just on the edge of the sun, making a nick in it.

Although not nearly so important nor so rare as transits of Venus, those of Mercury have an import-

ance of their own. The last transit of Venus was that of 1882, and it was very widely observed, in order to find the exact distance in miles of the earth from the sun. The next transit of Venus will be in the year 2004, but it will have no real importance to any of us now living on earth. Mercury last crossed the face of the sun in 1894; the next transit will be in 1914. The smallest planet of the solar system, the nearest to the sun, and the one with the quickest period, Mercury has some peculiarities of motion which have cast a little doubt on the exactness of the law of gravitation, the great fundamental principle which is the foundation of exact astronomy. Transits are observed in order more correctly to determine the planet's orbit, and so test this question, which is in reality one of the great astronomical problems. In addition these transits give a means of finding out whether the earth is a good timepiece, i. e., whether it is rotating uniformly on its axis. Prof. Simon Newcomb, from an investigation of all recorded transits, suspects certain small irregularities in the earth's rotation. These technicalities can be tested only by the slow and arduous process of measuring the photographs under the microscope, and comparing their results with those of former transits. It is too early to say what discoveries have been made from this latest transit of Mercury.

Examination of Handwriting.

It is remarkable how little use has been made of chemical or photographic methods in the examination of handwriting, especially in cases where the evidence of the expert has been inconclusive, and where, perhaps, the point in dispute might easily have been settled by the use of special reagents or of the camera.

Notwithstanding a general similarity in the composition of many commercial inks, the characters made with each on paper can usually be differentiated, and it is even possible sometimes to distinguish between writings done with the same ink but at different periods. When the dried writing done with these different inks is tested with various reagents, pronounced differences will usually be observed.

Erasures may be detected by treating the surface of the paper with distilled water and noting whether the absorption is greater in one part than another owing to the sizing having been removed at the same time as the writing. Skillful forgers have been known to replace the sizing by rosin and glue, and this may be detected by treating the paper first with hot water and then with alcohol, and again examining the surface. Traces of a prior writing may also in some cases be made apparent by the use of an intensifying reagent, such as potassium ferrocyanide.

Any mechanical erasure on the surface of the paper, which may hardly be shown by the greater transparency of the spot, is made much more apparent when photographed by transmitted light, the place then appearing as a blot. The slight spreading of the ink over the fibers of the paper from which the sizing had been partially removed might be all but invisible to the eye, and yet be plainly revealed in the roughened edges of the strokes in an enlarged photograph. Slight differences in the forms of letters or figures become enormous in the enlargement, and the addition of a "y" to "eight," for instance, or the change of "o" into "9" is readily detected.—Knowledge.

In addition to the above-mentioned methods, the microscope offers an effective means of detecting forgeries.