THE OPHTHALMO-DIAPHANOSCOPE.

The ophthalmo-diaphanoscope is an instrument for examining the fundus, or back of the human eye. It is the invention of Dr. Carl Hertzell, of Berlin, who claims that the instrument and its accessories supersede anything that has previously been in use. Briefly, the instrument consists of an eighty candle-power electric lamp, which the patient holds in his mouth, as far back as possible. This highly illuminates the retina of the eye from the back, and the surgeon, looking at it from the front, is able to make a much more satisfactory examination than was possible by means of reflected light and eye-mirrors.

Of course, the examination takes place in a totally dark room, while the patient wears a black mask over his face, in order to concentrate the effect of the illumination, holes being cut in front of the eyes, through which the surgeon makes his observations.

These are the essential points connected with the ophthalmo-diaphanoscope and its working. There are, however, a few other details connected with the invention which are of particular interest. The illumination, which is concentrated at one end of the tube, is ten times more powerful than that which is emitted by any other lamp previously employed in surgery for transmitted light. As we have seen, the normal candle-power is eighty; and a moment's reflection will convince the reader that it would be quite out of the question to make use of an ordinary lamp of this kind in the mouth, or, indeed, in close contact with any part of the body, because of the great heat which is generated. This difficulty has been surmounted by means of a continuous stream of cold water which circulates within the lamp. In the complete equipment, the water is stored in a glass reservoir supported upon a column, down the hollow of which the fluid passes to a flexible tube which carries the stream into the lamp, through which it circulates. A similar tube carries away the waste water, which is ultimately discharged into a vessel at the base of the apparatus.

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A necessary and most ingenious addition to the ophthalmo-diaphanoscope is the contact signal lamp, which is fixed to the column beneath the reservoir, that is to say, about on a level with the eyes of the surgeon when he is making an examination of the patient.

This lamp lights automatically just before all the water is discharged from the reservoir, so that no matter how much absorbed the surgeon may become in his examination, he will be at once apprised that the reservoir is almost empty by a sudden illumination of the darkened chamber. He can then at once switch off the current from the lamp, which, now that the cooling stream has ceased to flow, would become heated and cause discomfort to his patient.

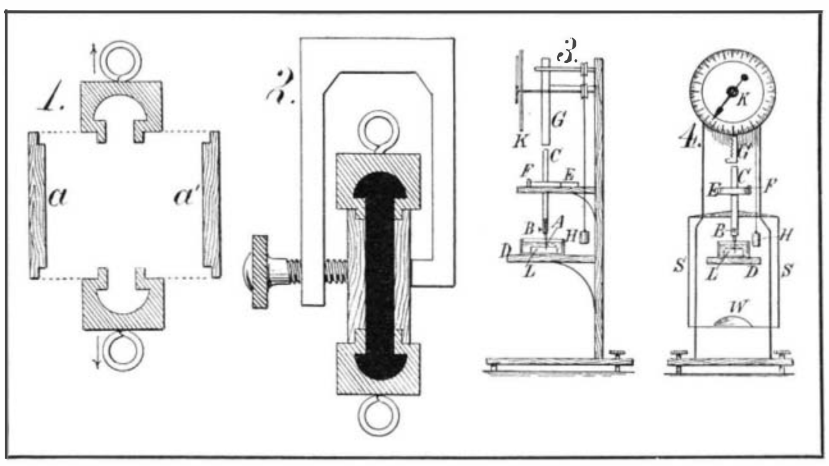
It should be added that the outer cover glass of the special lamp is readily removable, so that it may be sterilized after each use. Moreover, every part of the lamp may be had in duplicate; and as these are perfectly interchangeable, a broken or faulty part may be at once replaced. The whole apparatus has been devised with the utmost care; and it is claimed that even those who are unfamiliar with electrical appliances may quickly become accustomed to its use.

The ophthalmo-diaphanoscope was specially invented as an aid to diagnosing diseases of the eye; but it has proved of great service in examinations of the throat and nasal cavities, while it will probably prove of service to medical science in many other ways. Its chief advantage lies in the fact that an extremely powerful light may be obtained without heat radiation.

TESTING BITUMENS FOR PAVEMENTS.

In every direction, the industrial and scientific worlds are endeavoring to measure the properties of substances. An instance of this tendency was given in the article on "Testing for Hardness" in the SCIENTIFIC AMERICAN for August 29th, 1908. In the present article it is proposed to give some account of measurement efforts in a very different field of activity.

The sheet asphalt pavements so common in certain parts of the United States are composed of an admixture of some asphaltic cement and sand. It is quite important to have pretty exact information about this bituminous cement in advance of its use in paving mixtures. One reason for this is that the cements are by no means all alike. And second, the requirements for this use and that vary greatly. Thus it comes about that it is a matter of considerable importance to determine the characteristics of samples in course of manufacture or an advance of actual use. In fact, since the asphaltic cement is the controlling factor in the mixture used in sheet asphalt paving, it is very necessary to make this cement with just the properties suited to the particular case in hand. That is to say, asphaltic cement is a combination of refined asphalt and some tempering oil, as residuum petroleum. It will readily be seen, then, that the properties of the cement will vary with the relative quantities of the two ingredients, to say nothing of the characteristics of the particular asphalt and oil used. For practical purposes, then, it is found very desirable to know in advance whether the cement being made is going to be what is wanted.



Figs. 1 and 2 show mold for sample prism. Figs. 3 and 4 show side and front views of the Dow penetrometer.

There are two principal properties whose determination is sought. These are ductility and viscosity.

In order to measure the ductility, the following method, due to Mr. A. W. Dow, may be employed: A mold of four pieces is constructed, the plan view of these being shown in Fig. 1. These pieces are set up on a brass plate which forms the bottom. The side parts are held in position by a clamp, as shown in Fig. 2. The interior portion of the mold is in the form of a prism, 1 x 1 x 5 centimeters. The cement is now poured in, hot of course. When cool enough, the top is smoothed off. When the temperature has fallen to the point at which it is desired to make the test, the clamp is loosened, and the two side pieces *aa'* (Fig. 1) are removed. We now have a prism of cement held at the sides by clips—the end pieces of the mold. By inserting hooks in the eyes of the clips, it is easy to arrange matters so that these clips may be steadily drawn apart. This may be accomplished by hand. Mr. Dow mentions the rates of separation as 5 centimeters per minute for the temperature of 77 deg. F., and of 1 centimeter per minute for 20 deg. F. It is stated that "it is not safe for an asphalt having a consistency of 40 penetration at 77 deg. F. to pull less than 20 centimeters at this temperature." What is meant by "a consistency of 40 penetration" will become clear in the sequel.

In order to measure the viscosity (consistency) of a cement, recourse is had to a device for measuring the depth of penetration accomplished by a weighted needle in a given time. Prof. H. C. Bowen is said to have invented the pioneer machine about twenty years ago. Several devices have been developed since. The one which is probably most in use at the present time was devised by Mr. Dow. But this latter has now been improved upon by Messrs. Richardson and Forrest.

In the Dow machine, a broad upright rises at the rear of a base, as shown in vertical section in Fig. 3. The specimen of asphaltic cement is contained in a small tin box *L* immersed in water in a suitable receptacle. This last rests upon the shelf *D*. An aluminium rod *C* is held by a clamp *E*, controlled by a button *F*. A No. 2 cambric needle *A* is inserted in a brass rod, and this latter is held in position in the aluminium rod by the screw *B*. Attached to the aluminum rod *C* is the framework *SS*, Fig. 4, carrying a weight *W*. It will readily be seen now that by locking the clamp *E* open, by means of the button *F*, the needle, weighted by the parts *C*, *SS*, and *W*, may be brought into contact with the upper surface of the specimen, and allowed to begin penetration.

There are two remaining things for which mechanism must be arranged. There must be some means of measuring the time and the amount of penetration. The former of these is quite a simple matter. A pendulum beating half-seconds is arranged at some convenient point of attachment. The second requirement is accomplished as follows: In Figs. 3 and 4, *G* is a rack meshing with a pinion back of the dial *K*, and controlling the indicator. At the rear end of the spindle carrying the pinion is a drum. A rather thick thread is wound about this drum, and weighted at its lower end by the weight *H*. This last is of such amount as just to counterbalance the weight of the rack on the pinion. Consequently, if the lower end of the rack is brought into contact with the aluminium rod *C*, it will not contribute any influence to the penetration of the needle. At the beginning of the test, the lower part of the rack is brought into contact with *C*, and again at the conclusion. The difference in position of the rack will, therefore, give the amount which the needle has

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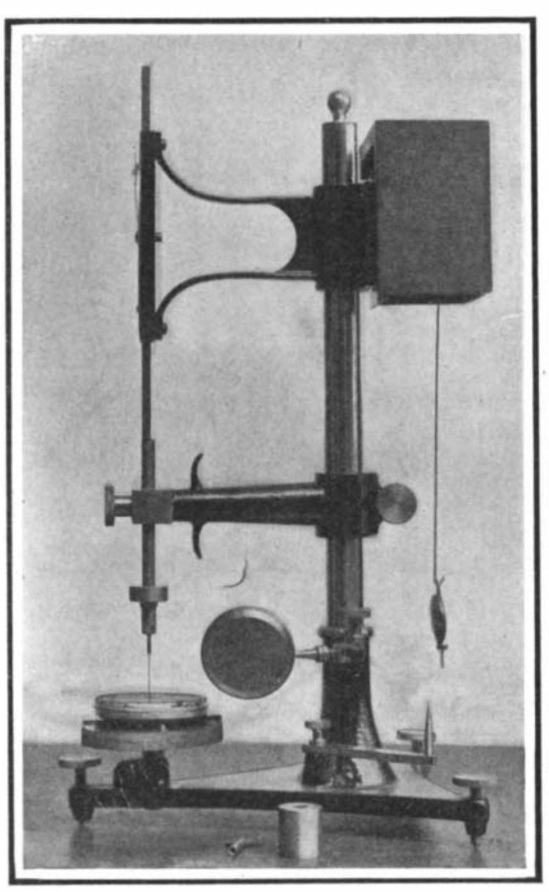
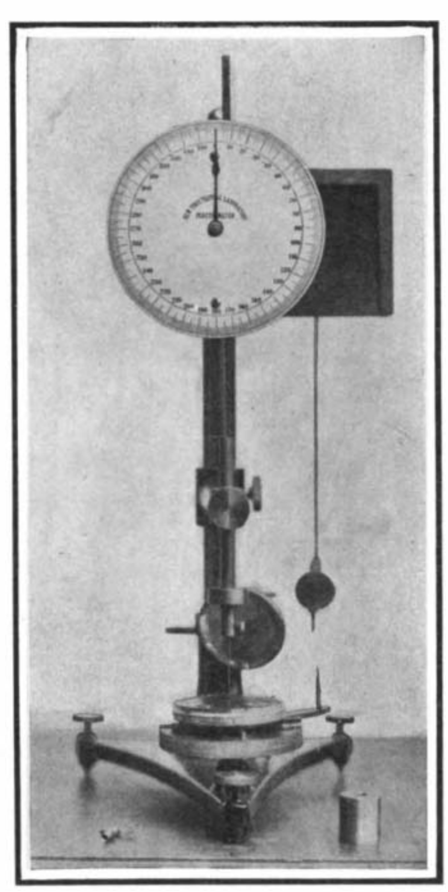


Side view of the improved penetrometer.



Pendulum and indicator dial.

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penetrated into the specimen. As it is desired to ascertain this with considerable accuracy, it is necessary to magnify the displacement of the rack. This is the office of the pinion and indicator. The dimensions of these are so arranged that a fall of 0.1 millimeter (= 0.0039 inch) will correspond to one division on the dial.

Penetration at most temperatures is permitted for just five seconds. At the beginning the reading of the dial is noted, and also at the close. The difference will show the amount of penetration in terms of tenths of a millimeter. But if the test is made at the freezing point of water, or at a lower temperature, the penetration is allowed to continue for a full minute. The weight carried by the needle is not always the same. For temperatures that do not rise above 32 deg. F., the weight is 200 grammes. At 77 deg. F. it is 100 grammes. For a temperature of 100 deg. F. or higher, the weight is reduced to 50 grammes. As the apparatus depending upon the needles weighs just 50 grammes, apart from the weight *W*, the requisite variations in load are readily made.

The question arises here, however, as to whether there is any point of view from which the amounts of penetration at the various temperatures may be regarded as comparable. Thus Mr. Dow gives the penetrations of three different asphaltic cements, A, B, and C, as follows:

PENETRATION NUMBERS.

Temperature.	A.	B.	C.
32 deg. F.	10	13	25
77 deg. F.	55	47	45
100 deg. F.	150	110	75
115 deg. F.	350	220	120

The amount of penetration of A at 32 deg. F. is 10; at 77 deg. F. it is 55. But are the cases comparable? Can we say with an justice that the viscosity in the one case is 5½ times that in the other? The penetration of 55 was accomplished with half the load and in one-twelfth the time. Offhand, it would seem that the number 55 should be 24 times as great.

There are, however, two other influence at work—one tending to make the number 10 too large, the other tending to reduce it. Falling bodies—and such a body the penetrating needle is—do not have a uniform velocity, but become accelerated. On the other hand, as pointed out by Mr. S. Whinery, the depth of penetration is not a measure of the work done, the needle being in fact of a conical form. The farther the penetration, the greater the amount of material displaced, and the greater the frictional resistance (due to adhesion) per unit of penetration. However, it is conceivable that the form and material of these counteracting factors might be so adjusted as to nullify each other.

With the disturbances arising from acceleration and from variation in resistance eliminated, there still remains the apparently faulty method of varying the weights and the time. It would seem better to maintain these factors precisely the same, or else correct the numbers so as to have them comparable, whatever the temperature. However, the Dow machine has, apparently, proved itself of great value in actual practice. An improved machine has recently been put on the market, in which the framework arrangement supplying weight for the needle is entirely discarded, being replaced by a tube containing the weight and holding the needle. This tube slides in a guide-arm supported by a substantial upright. The extra weight, as may be seen in the engraving, is placed low on the tube, and so will tend to deflect it but little, if at all. The table carrying the specimen is supported by a screw arrangement. This enables the specimen to be brought into contact with the needle at zero position. The mirror, seen at the bottom of the apparatus, enables the operator to determine when contact between needle and specimen has been secured. The counterbalancing arrangement used in the Dow apparatus is replaced by the pressure of a spring. The remaining features are essentially the same. The rejection of the framework device weighting the needle and the string counterbalance would seem to be steps in advance, especially if the replacements will yield as good results.

A practical word may be added as to the results shown in the table of penetrations. The cement A is regarded as showing as great a variation as is safe for pavement use. A greater variability in viscosity at the different temperatures would be difficult, if not impossible, in practical application. If soft enough for 32 deg. it would be too soft at high temperatures. C shows a steadiness which would be valuable if it were not for an accompanying bad quality. Its ductility (at 77 deg. F.) is but 20, while A is 300. B shows less variability in viscosity than A and more than C. Its ductility (at 77 deg. F.) is 75.

The susceptibility to change in hardness resulting from application of heat or to ageing may be ascertained by utilizing the penetrometer.

It will be seen from a consideration of the facts which have been recounted, that the tests for ductility and viscosity are of great practical utility.

Trigger mechanism, E. R. Williams	938,192
Trigger mechanism, single, P. H. Robinson	937,864
Trolley, O. W. Brenizer	937,761
Trolley pole, J. Harsen	937,935
Trousers, F. H. Sprague	937,883, 938,347
Trowel, P. Neerup	938,070
Truck, S. Craig	938,301
Truck lateral motion roller bearing device, car, J. C. Barber	937,752
Trunk tray support, C. F. Rom	937,866
Tube mill cement feeder, A. E. Sparrow	938,176
Tunnel, subaqueous, E. W. Moir	938,265
Turbine, elastic fluid, F. Hodgkinson	937,996
Turbine, elastic fluid, S. Z. de Ferranti	938,309
Turbine muffler and fly-wheel, combiner, J. A. Lawson	938,253
Typewriter attachment, W. A. Tompkins	938,354
Typewriter keyboard lock, W. P. Kidder	938,059
Typewriting machine, A. T. Brown	938,119
Typewriting machine, A. W. Steiger	938,178
Typewriting machine, Tanner & Jones	938,350
Typewriting machine, J. B. Secor	938,439
Typewriting machine, L. D. Broughton	938,454
Ultramarines, manufacture of, F. Bellet	938,408
Umbrella, folding, J. T. Manning	938,007
Valve, H. Gibbs	937,931
Valve, F. Schreidt	938,080
Valve, C. Wainwright	93 ,292
Valve, air brake safety, O. Gibson	937,991
Valve, barrel, C. F. Terney	938,288
Valve, check, H. F. Cunning	937,773
Valve, engineer's, W. Ohlsen	938,169
Valve gear, A. M. Wolf	938,360
Valve gear for explosive engines, A. A. Karcher	938,386
Valve, pressure regulating, H. F. Cunning	937,774
Valve, safety gas, F. D. Gregory	937,791
Valve, vacuum air, C. A. Dunham	938,226
Vapor burner, R. C. Bierbower	938,365
Vault, burial, H. Lanius	938,250
Vault, burial, G. Hess	938,379
Vehicle brake, R. R. Hart	938,322
Vehicle, dumping, C. Miller	938,012
Vehicle fender, C. W. M. Guhle	938,053
Vehicle, motor, H. Pieper	937,859
Vehicle motor fore carriage, Vignle & Forget	938,094
Vehicle reach, M. R. Hull	937,940
Vehicle ventilator, F. R. Harvey	938,232
Vehicle wheel, E. Hartman	937,798
Vehicle wheel, E. Hopkinson	937,808
Vehicle wheel, L. M. Wolffsohn	937,910
Vehicle wheel, W. D. Trigalet	938,184
Vending machine, coin controlled, H. A. Ladue	937,820
Vending machine coin controlled mechanism, J. Fritsche	938,419
Vending machine, picture, T. R. McQuillan	937,949
Vent, sanitary, W. S. Tuttle	937,8 3
Ventilator. See Vehicle ventilator.	
Ventilator, H. F. Maranville	938,067
Vibrating, tension, and operating table, J. Lend	937,825
Violin tuning peg, P. Rose	938,079
Voting booth, E. Hinton	937,806
Voting machine, J. H. Dean	938,126, 938,412
Wagon brake, E. A. Johnson	938,241
Wagon runner, F. Kindahl	937,999
Wagon, school, Parry & Byers	937,953
Wagon shock loading attachment, farm, F. X. La Londe	938,152
Wall, retaining, M. M. Upson	938,091
Wp carriage, H. D. Colman	938,124
Warp frame, W. L. Dorr	938,130
Washboard, J. E. Byrnes	937,985
Washer, H. A. Davis	938,302
Watchmaker's tool, C. H. Pratt	937,869
Water elevating apparatus, O. A. Reed	938,078
Water elevator, J. Montgomery	938,266
Water heater, electrically operated, J. A. Hunnewell	938,237
Water heating apparatus, A. C. Dunham,	937,776, 937,777
Water purifying apparatus, H. Reisert	938,075
Water tube boiler, H. F. Ely	937,782
Weather strip, W. C. F. Beale	938,107
Weight indicating mechanism, Heimann & Flatow	938,054
Welding machine, chain, F. H. Howard	938,056
Wheel, E. Stewart	937,969
Wheel, G. H. Treadgold	937,973
Whiffletree, quick releasing, E. A. Carkin	938,120
Window balcony, portable, T. Hull	938,382
Window ventilating device, C. V. Walker	937,899
Wire stretcher, W. W. Snyder	937,881
Wire stretcher, J. R. Wade	938,029
Wood, bending, J. T. Breece	938,366
Wood, preserving, Von Heidenstam & Friedemann	937,802
Wrench, D. W. Shaffer	937,966
Wrench, C. Sauer	938,020
Wrench, E. D. Hamilton	938,319
Wristband, H. J. Collis	937,769
Yoke, neck, G. E. Wheeler	938,295

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., Inc., 361 Broadway, New York.

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