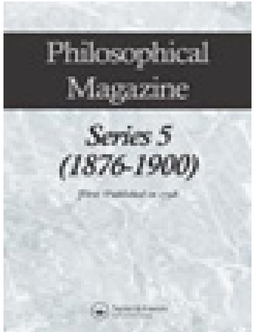
Philosophical Magazine Series 5

ISSN: 1941-5982 (Print) 1941-5990 (Online) Journal homepage: http://www.tandfonline.com/loi/tphm16



XXXV. On a new form of the reflective goniometer

W.H. Miller M.A. F.R.S.

To cite this article: W.H. Miller M.A. F.R.S. (1876) XXXV. On a new form of the reflective goniometer , Philosophical Magazine Series 5, 2:11, 281-285, DOI: 10.1080/14786447608639106

To link to this article: http://dx.doi.org/10.1080/14786447608639106

Published online: 13 May 2009.

against the hypothesis that it is methyl pyridine. In all methyl compounds with which we are acquainted, chlorine is easily introduced in place of the hydrogen of the methyl group ; and, also, the methyl group is usually easily oxidized to a carboxyl group. This is certainly not the case with picoline ; for, as Dewar has shown, it yields, when oxidized with potassium permanganate, an acid which he named dicarbopyridenic acid, in which two atoms of hydrogen are replaced by carboxyl groups ; and pyridene, in fact, is easily prepared from it by distilling it with lime. Wright supposes that Dewar's picoline may have contained lutidine, and that the acid may have resulted from the oxidation of two hypothetical methyl groups in lutidine. But I have succeeded in preparing dicarbopyridenic acid (a better name for which would be pyridene dicarbonic acid) by a process similar to Dewar's ; and I find that from 9 grms. of picoline about 5 grms. of dicarbopyridenic acid are obtained ; and surely that is a proof that all the acid is not derived from lutidine. I have already, in the course of some preliminary experiments, made it probable that the alcohol and aldehyde of this acid exist ; and I hope to be able to transform the alcoholic into methyl groups, and so produce true dimethyl pyridine. The facts elucidated are these:—(1) The carbon and nitrogen are evidently not combined in the manner in which they exist in a nitrile or in a carbamine ; otherwise caustic potash would produce the usual decomposition. (2) Picoline does not contain an amido-group; for not only does it refuse to yield an amido-compound with an acid chloride, but also it is impossible to form a compound with two alcohol radicals. (3) Picoline has the capacity of uniting loosely with two atoms of a halogen, either when it is free, or combined with an acid, or with an alcoholic bromide or iodide. This probably shows that it is an unsaturated compound.

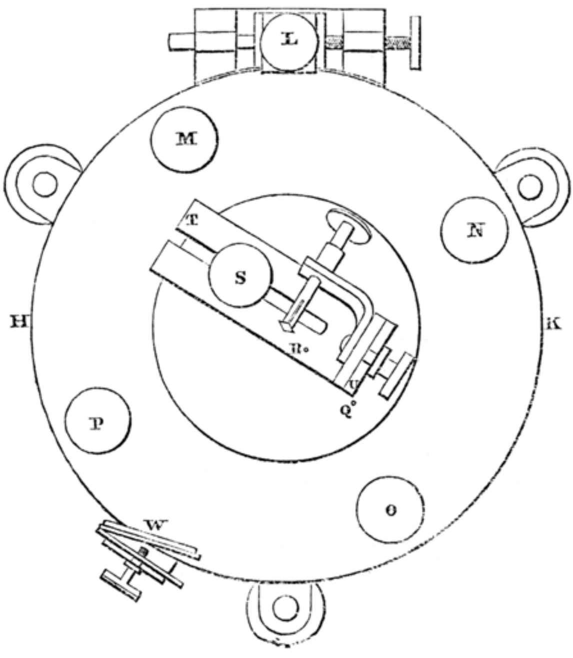
I propose to extend my researches on picoline with the view of ascertaining its real constitution.

XXXV. *On a new Form of the Reflective Goniometer. By* W. H. Miller, *M.A., F.R.S., Fellow of St. John's College, and Professor of Mineralogy in the University of Cambridge* *.

After the publication of a description of Mitscherlich's Goniometer (*Berlin. Abhandl.* 1843, p. 189), and of those employed by Babinet, Haidinger, v. Lang and Schrauf, an account of any other modification of this instrument may appear very superfluous. I believe nevertheless that it is

* Communicated by the Crystallometric Association.

possible to eliminate some sources of error, and to render the observations more accurate than with the other reflective goniometers in ordinary use, and in some instances to obtain the means of making observations otherwise impracticable. Besides, the construction of the new form is simple, and does not demand any great nicety of workmanship, except of course in the graduation of the circle and verniers. The instrument, made by Messrs. Troughton and Simms, has for its support a tripod with levelling-screws, carrying a fixed disk 200 millims. in diameter and 5 millims. thick, tapped for screws at the points D, E, F, G—by which supports for the vertical mirror, telescope, &c. mentioned later on can be attached to the instrument, in a circle concentric with the disk, having a radius of 88 millims., the diameters through those points making angles of 45° and 32° with a fixed diameter of the disk. The graduated circle, also 200 millims. in diameter and 8 millims. thick, is divided on its edge into spaces of 20′ each, the degrees being numbered up to 360°, is read off to 20″ by each of two verniers H, K attached to the circular plate, and is provided with a clamp and slow-motion at L. It is tapped for screws at the points M, N, O, P distant 90° from one another, and about 19 millims. from the edge of the circle. A circular disk 100 millims. in diameter, and 8 millims. thick, is tapped for



screws at the points Q, R, S, 38, 13, 25 millims. distant from the centre, for securing the crystal-holder to the instrument in a convenient position. This disk is capable of revolving round a pin the ends of which enter holes in the centres of the disk and graduated circle. A rectangular piece of metal T U, having each arm 95 millims. long, 30 millims. wide and 5 millims. thick, with slits the width of which is very little larger than the diameter of the screw, can be securely clamped to the disk by a screw passing through the slit in the horizontal arm. A bar in which are inserted two screws, by which it can be secured to the vertical branch of T U, carries at its upper end the ordinary Wollaston's branch, to which the crystal is secured by a cement employed by Wollaston, consisting of beeswax melted with a little olive-oil, honey, and lampblack, and stirred while cooling to prevent the séparation of the components. The crystal being now adjusted above every part of the instrument, about 195 millims. above the plane on which it rests, is brought into the axis by making T U slide and revolve. The screw being now tightened, the crystal revolves with the circle without any danger of the small angular displacement which is liable to occur, according to Dauber (Poggendorff's *Annalen*, vol. ciii. 1858, p. 107), in the best constructed goniometers when the circle is vertical and the adjustment is by sliders in grooves making right angles with one another. This method of bringing the crystal into the axis of the circle can also be applied with advantage to the small Wollaston's goniometer.

The image of the bright signal is much more distinct when the incidence is as direct as possible, more especially when the face under observation is striated or partially coated with any foreign matter. A small angle of incidence is hardly obtainable with a vertical circle or with a horizontal circle in most localities, as long as the faint signal is seen directly.

Instead of employing an object seen directly for the faint signal, it was suggested independently by A. F. E. Degen (Poggendorff's *Annalen*, vol. xxvii. 1833, p. 557) and E. Sang (Edinb. New Phil. Journ. vol. xxii. 1837, p. 213) that the image of a line seen by reflexion in a mirror could be employed for the faint signal. They failed, however, to obtain the greatest advantage from the employment of the mirror; for though theoretically correct, this is practically inconvenient, because the brightness of the reflection in the mirror very commonly extinguishes the reflected image in the face of the crystal. A better mode of procedure is to place a screen with a narrow vertical slit covered on the side furthest from the observer with thin paper, making at the crystal an angle of from 3° to

5° with the bright signal, and adopting the image of this in the dark glass mirror W for the faint signal. The mirror, about 40 millims. wide and 30 millims. high, is cemented to a thin metal plate bent so as to make an angle of about 30°, while by means of a screw tapped in the other part it can be fastened to the upper end of a strip of brass 208 millims. long, 25 millims. wide and 3 millims. thick, having slits at each end to receive screws, and bent at right angles at a point 40 millims. from the lower end.

By making the mirror revolve through a small angle round the screw which fastens it to its support, and the support round the screw by which it is fastened to the instrument, the mirror is capable of suitable adjustment. A second mirror and support will be found useful, the two mirrors being attached on opposite sides of a vertical plane passing through the centre of the instrument and the source of light. A mean of the results will be free from the errors depending upon the first powers of the eccentricity. For various reasons the accuracy of the observation increases when the angle of incidence of the light on the crystal is small. This angle can be easily reduced to less than 15°.

The accuracy of the observations is undoubtedly increased by the use of collimators; they also allow the observation to be made when the space at the observer's disposal is very limited. They may have object-glasses of from 20 millims. to 30 millims. aperture and 500 millims. or more focal length. The two collimators are mounted on supports having each three nearly equidistant notches, so that one resting in the middle notch of each support may have its axis passing through the axis of the goniometer at a distance of 132 millims. above the plane of the graduated circle: it has in its principal focus a vertical adjustable slit, through which the light of the sun is thrown from a heliostat-mirror in the direction of the axis of the collimator. It is sometimes convenient to place a lens in front of the slit in order to enlarge the emergent pencil of light. The other collimator, resting in either pair of the corresponding notches, may have its axis passing nearly through the middle of the dark glass mirror. The end opposite to the object-glass is covered with a plate of glass ground rough on the outer surface, and covered on the inner surface with indian ink scratched away in a vertical diameter.

When the crystal is large, or is implanted on a matrix of some considerable weight, it is obviously impossible to secure and adjust it on the ordinary Wollaston's branch. In such cases it is fixed in a sort of vice having three parallel claws, one of which is movable. By screwing up this claw the crystal is secured, and then adjusted by making the vice revolve round one or the other of its two axes, making right angles with one another. Also the distance between the faces under observation may be greater than the aperture of the small telescope. The difficulty arising from this circumstance may be overcome by interposing a plate of glass mounted so as to be adjustable in azimuth and zenith-distance, supported by a stem secured to the under plate of the instrument. The observation is made by bringing the image of A seen by reflexion in the face of the crystal into coincidence with the image of the signal B seen by reflexion in the vertical plate of glass.

A small telescope having a power of about 3 may be applied, either for the purpose of observing with greater precision the coincidence of the image of A, as seen by reflexion in a face of the crystal, with the signal B or its image, or of bisecting the reflected image of signal A with the vertical spider line. The telescope is attached to an upright support, the foot of which is fastened to the upper surface of a strip of brass bent twice at right angles in opposite directions, the upper surface of the brass plate being in the plane of the upper surface of the graduated circle, and secured by a screw to the under surface of the base-plate.

By attaching the upright stem of the telescope by one of the screws to the graduated circle, the telescope becomes available for measuring the minimum deviation of a ray of any colour through two inclined faces of a crystal.

The best bright signal is the light of the sun reflected from the mirror of a heliostat through a slit so adjustable that the middle of it remains fixed in space while its diameter admits of being varied. An image of the sun in the focus of a lens of about 30 millims. focal length, formed by the light reflected from a plane mirror, is sufficient in most cases. Much inferior to these is the light of a lamp or that of the sky reflected by a plane mirror through a small opening in a screen. It is hardly necessary to remark that perfect distinctness of vision of the signals, which should be equidistant from the centre of the instrument or very nearly so, is essential to accuracy. When the eye of the observer is not adapted to the distance of the signals, the use of a Galileo's telescope of low power will greatly increase the accuracy of the result.