A Geological Excursion Handbook for the Bristol District. By Prof. Sidney H. Reynolds. Second edition. Pp. 224. (Bristol: J. W. Arrowsmith, Ltd.; London: Simpkin, Marshall, and Co., Ltd., 1921.) 5s. net.

THE second edition of this useful handbook reproduces the first in all essential features. The author is, however, well known for his untiring investigations into the geology of his district, and the recent researches of his pupils and himself have necessitated a number of minor alterations in the descriptive portion of the book.

The chief additions relate to the igneous rocks associated with the Carboniferous Limestone, and four out of five new text-figures illustrate the outcrops and exposures of these rocks at Goblin Combe and in the neighbourhood of Weston-super-Mare.

It is to be regretted that page-references are lacking, not only in the list of illustrations, but also in all the other references made to text-figures. T. F. S.

Letters to the Editor.

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Ruling Test Plates for Microscopic Objectives: Sharpness of Artificial and Natural Points.

TEST plates for microscopic objectives should consist of alternate opaque and transparent lines approximately of the same width, and placed on a plane surface (not grooves engraved on transparent material). Considerable difficulty has been found in producing such lines when the distance between them is less than about 1/2000 in. They might be made by ruling on thin opaque films, and, so far as opacity is concerned, films of silver or other metals chemically deposited on glass would meet the case; but the intrinsic strength of these films is greater than their adherence to the glass, and the whole of the metal is torn away by the ruling point when the lines are close together. In many trials I have never succeeded in ruling on chemically deposited silver at even 2000 lines per inch. I have found, however, that films of certain aniline colours dried on glass are well adapted for the purpose, their opacity being so intense as to show a fair depth of colour even when the thickness of the film is a very small fraction of a wave-length of visible light. Their adherence also to the glass is greater than their intrinsic strength, and, so far as my experience goes, the limit to the fineness of the lines which may be ruled on them is not reached until the spacing of the lines is less than the thickness of the film.

In ruling lines on such films the load on the ruling point should be sufficient to remove the material of the film, but not to scratch the surface on which it is laid, and considering how soft the film is compared to glass or quartz, it seemed worth while to see whether a steel point might not be substituted for diamond in the ruling process.

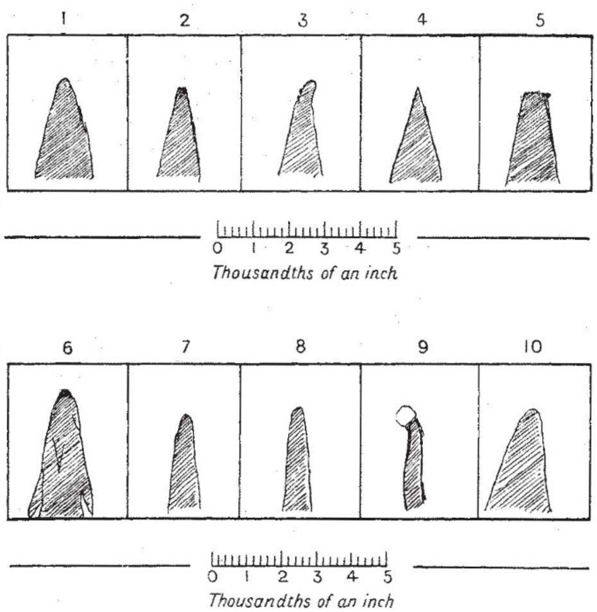
In looking into this question, one of the first things to be noticed was the extraordinarily small load which must be placed on the point. Suppose, for instance, that it is required to rule at the rate of 100,000 per inch, the area of the point in contact with the plate must not be greater than $(1/200,000)^2$ in., and since a grain is roughly about 1/15,700,000th of a ton, a load of 1 grain on the point will produce a pressure of more than 2500 tons per square inch. Even hard steel would not stand a hundredth of this pressure for long, and though I am not aware that any accurate measures have been made of the pressure required to scratch glass, I should expect it to be less than 10 tons per square inch.

For ruling lines at 100,000 per inch, therefore, the load on the point should be not greater than 1/200th of a grain, and the holder in which the point is carried by the ruling machine would have to be made with a very small mass, and counterbalanced.

To find out whether it was possible to grind steel points to the requisite fineness, I began by examining the points of needles in the state in which they are sold.

They varied in the degree of sharpness, but their extremities were all somewhat parabolic in section, with an average minimum radius of curvature of the order of 1/20,000 in. (Fig. 1).

On trying to secure a finer point by grinding, it was found that, using the lightest pressure which could be applied by hand to a needle mounted at the end of a light reed, the point continually broke away,



FIGS. 1 to 10.—(*Traced from photographs*) 1, needle: average point as sold. 2, needle: ground under a load of 15 grains; see broken point. 3, needle: softened to show bending under the same load. 4, needle: ground under a load of 1 grain (about). 5, needle: dropped, point downwards, on a glass plate; fall 1 in. 6, spine of cactus (Opuntia): barbs much sharper than the apex. 7, thistle spine. 8, gorse prickle. 9, stinging-hair of nettle: this is a thin-walled tube; a drop of poison is issuing from the end. 10, bramble: immature prickle; older prickles are not so sharp.

leaving a rough end somewhat less than 1/10,000 in. in diameter (Fig. 2). On repeating the process with a needle which had been slightly softened, the end tended to become cylindrical, and the cylindrical part broke off when its length was about two diameters (Fig. 3). (This cylindrical end is analogous to the "wire edge" left when sharpening a rather soft knife or chisel.)