itato Nazionale Energia Nucleare

MICROSAMPLING TECHNIQUE OF CERAMIC FUELS AT CASACCIA HOT LABORATORY

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CONTENTS

1. INTRODUCTION

Small samples from selected points are often needful for the special analyses on irradiated ceramic fuel. The analyses are required, as post-irradiation examination, in order to understand fission product migration, fission gas release, microstructural and stoichiometric changes and derived phenomena.

Our approach to the problem was the use of an ultrasonic drilling technique, experienced at about the same time in other laboratories (1) (2).

This technique was first set up and proved highly reliable out of cell for radial and axial power distribution studies on experimental rods irradiated in a low neutron flux as physical mock-up (3).

2. DESCRIPTION OF THE EQUIPMENT

The ultrasonic drill, we found suitable for microsampling, was the 100 watts type manifactured by MEL Equipment Ltd (U.K.).

This type has a better performance than the smaller 60 watts one since it incorporates a cooling device (fan) for the transducer, essential for prolonged use in hot cell.

Only minor alterations were adopted in order to make it reliable for drilling samples at preselected points of the specimens.

The modified MEL drill is shown in figg.1-2. The latter was shot through the window during operation in hot cell. Both figures show a small specimen holder, mounted on a compound sliding table, which accomodates the samples of the required size, and allows the X and Y motions necessary for an accurate positioning. One revolution of the capstans being equivalent to a 1 mm movement.

Other ancillary equipments on the drill were expecially adapted for remote control . The principals were as follows:

- two fixed mirrors for reading the micrometric capstans

- distribution of fission products (Zr 95, Cs 137, Ce 144, Ru 106).

Heat rating of the sample shown in fig.9 was abput

$$\int_{0}^{T_{o}} K(T)dT \sim 60 \text{ w/cm.}$$

4. CONCLUSIONS

The standard drilling technique, that has been satisfactorily in use for about five years in our labora= tory contemplate the use of a 100 watts ultrasonic drill, and probes of about 1.5 mm O.D.

A development of the technique which gives rise to difficulties of an other order of magnitude has been imposed by the geometry and phenomena of the fuel for fast reactors.

It includes the use of probes down to 0.4 mm diameter with the resulting difficulties of recovering, handling and weighing drilled cores of only few milligrams of weight.

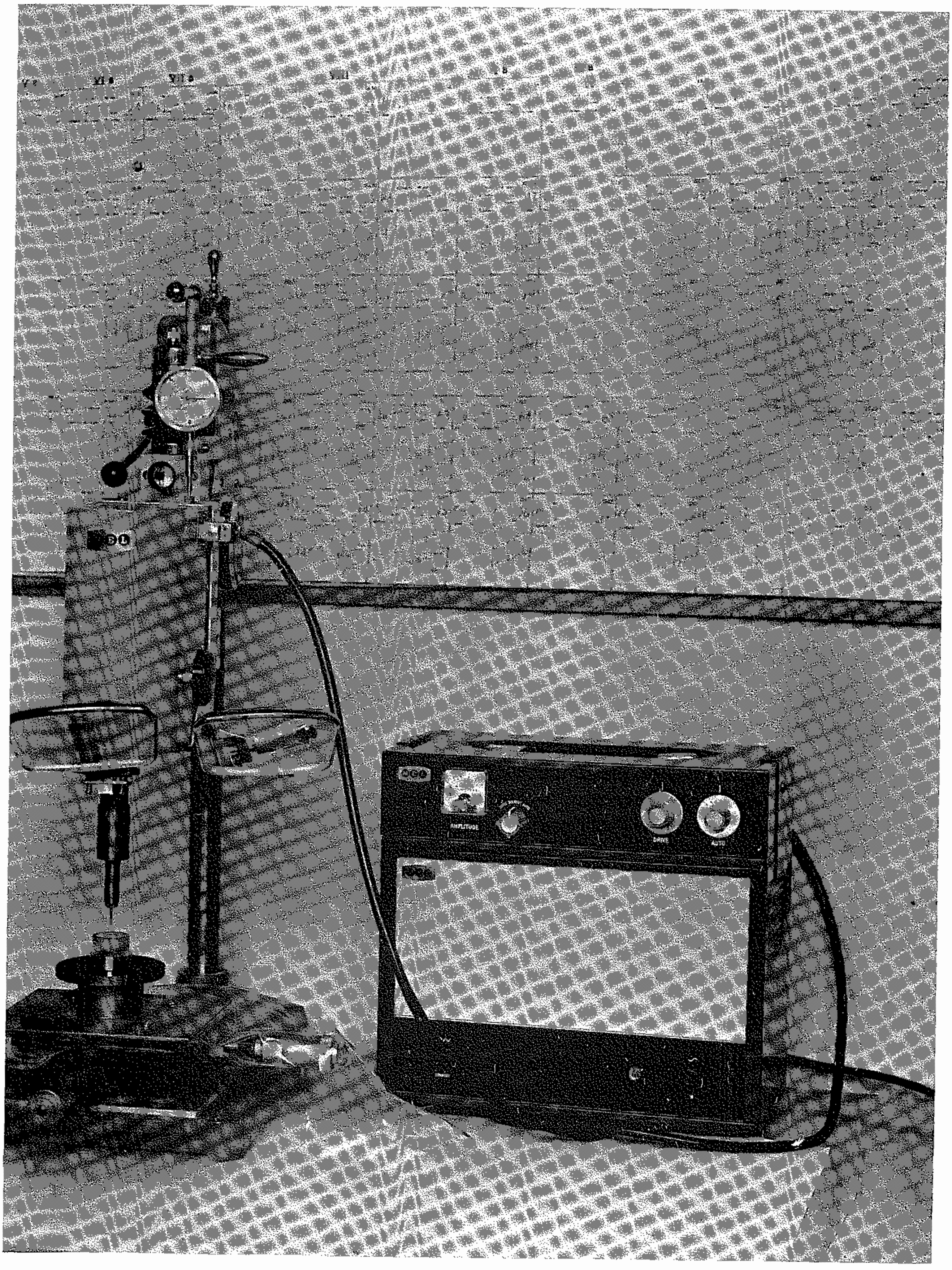
A proper choice of the probe and abrasive materials and a careful manipolation has provided a first set of positive results.

5. REFERENCES

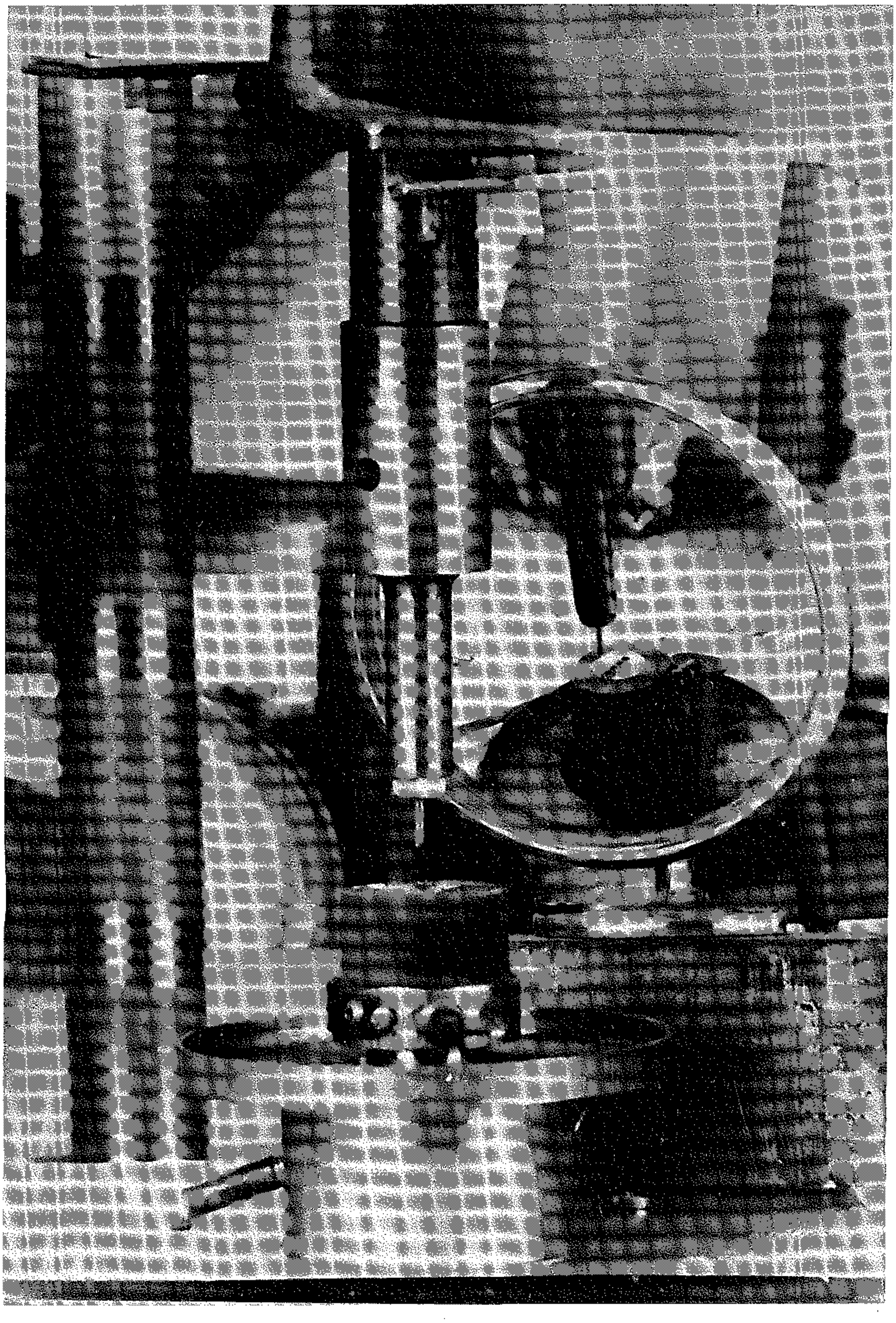
1. I.H.Crocker, R.G.Hart - AECL 2522-Dec 1965

2. N.Coquerelle - EUR 3619 f. 1967 - 14th meeting hot lab. committee

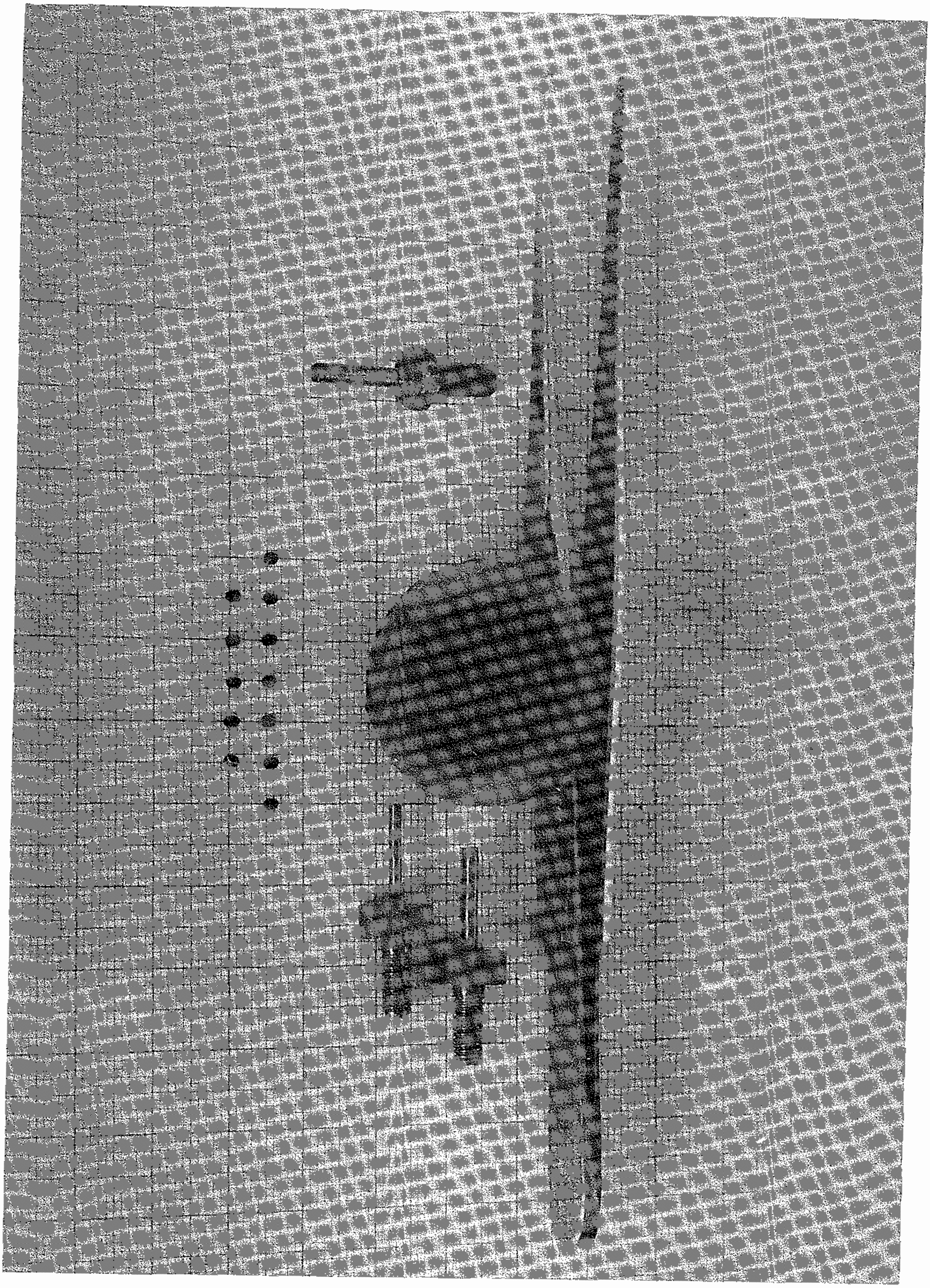
3. L.Bozzi, A.Gibello, G.Pugnetti - Energia Nucleare 15,5, (1968) 322



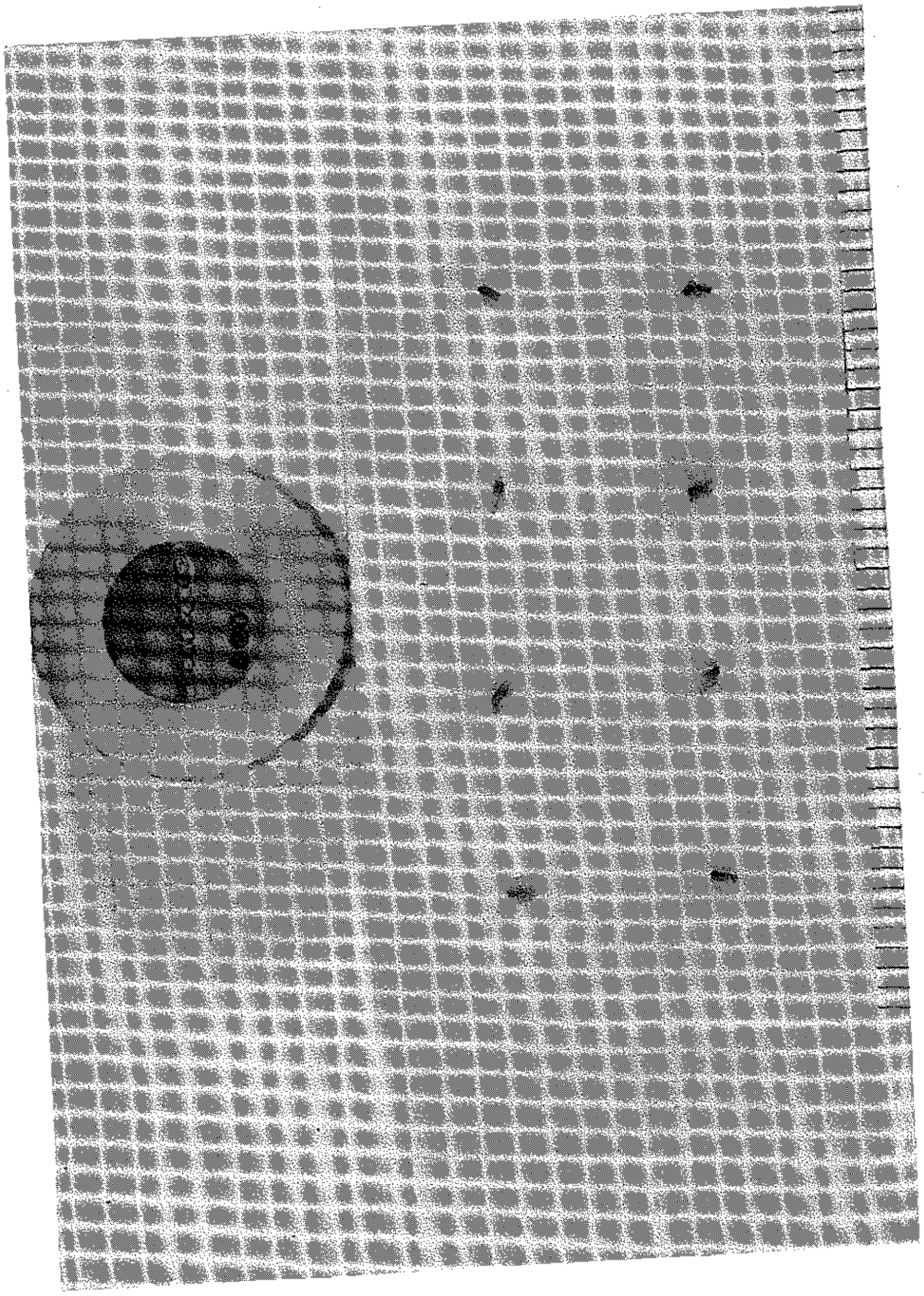
1. Modified MEL drill



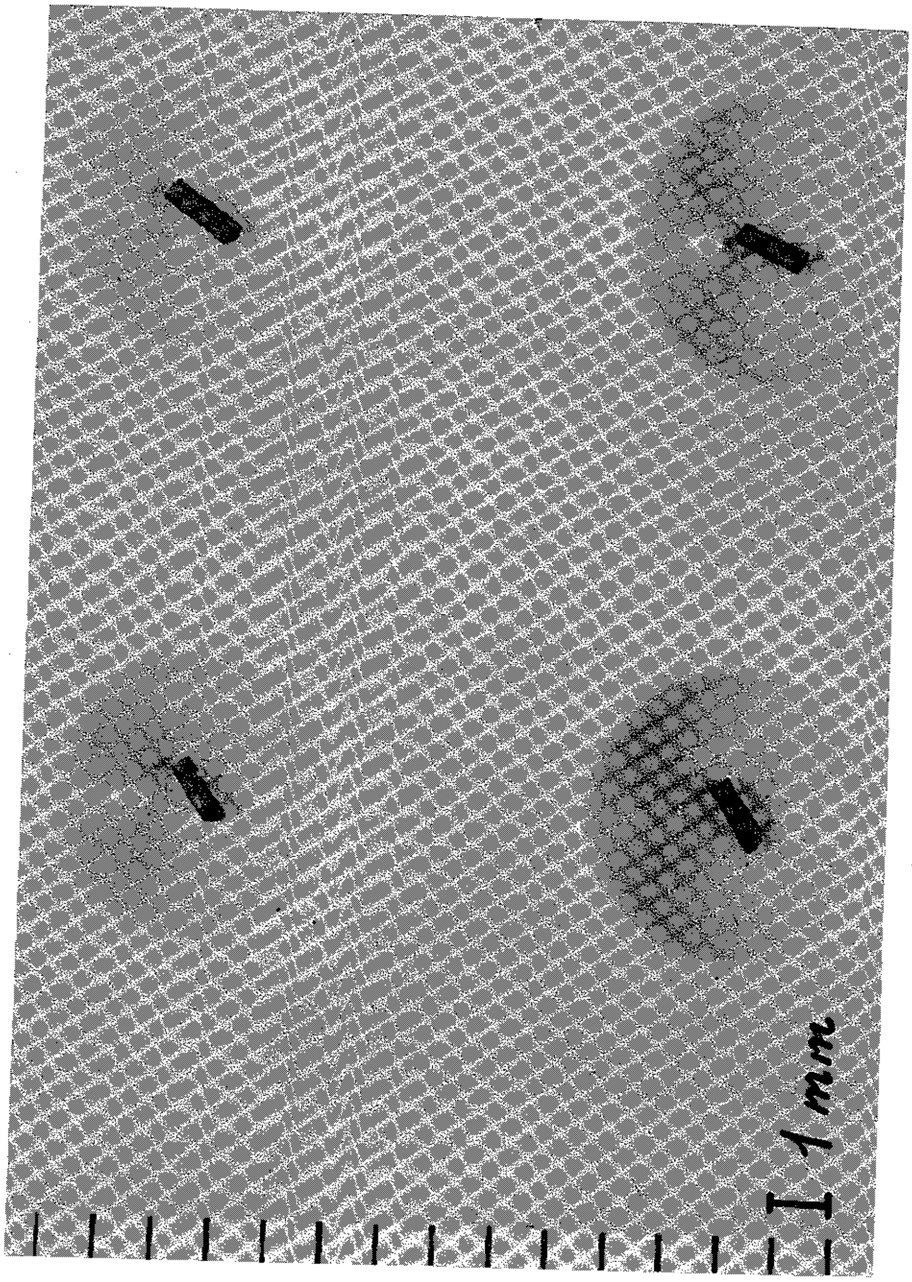
2. Modified MEL drill (detail)



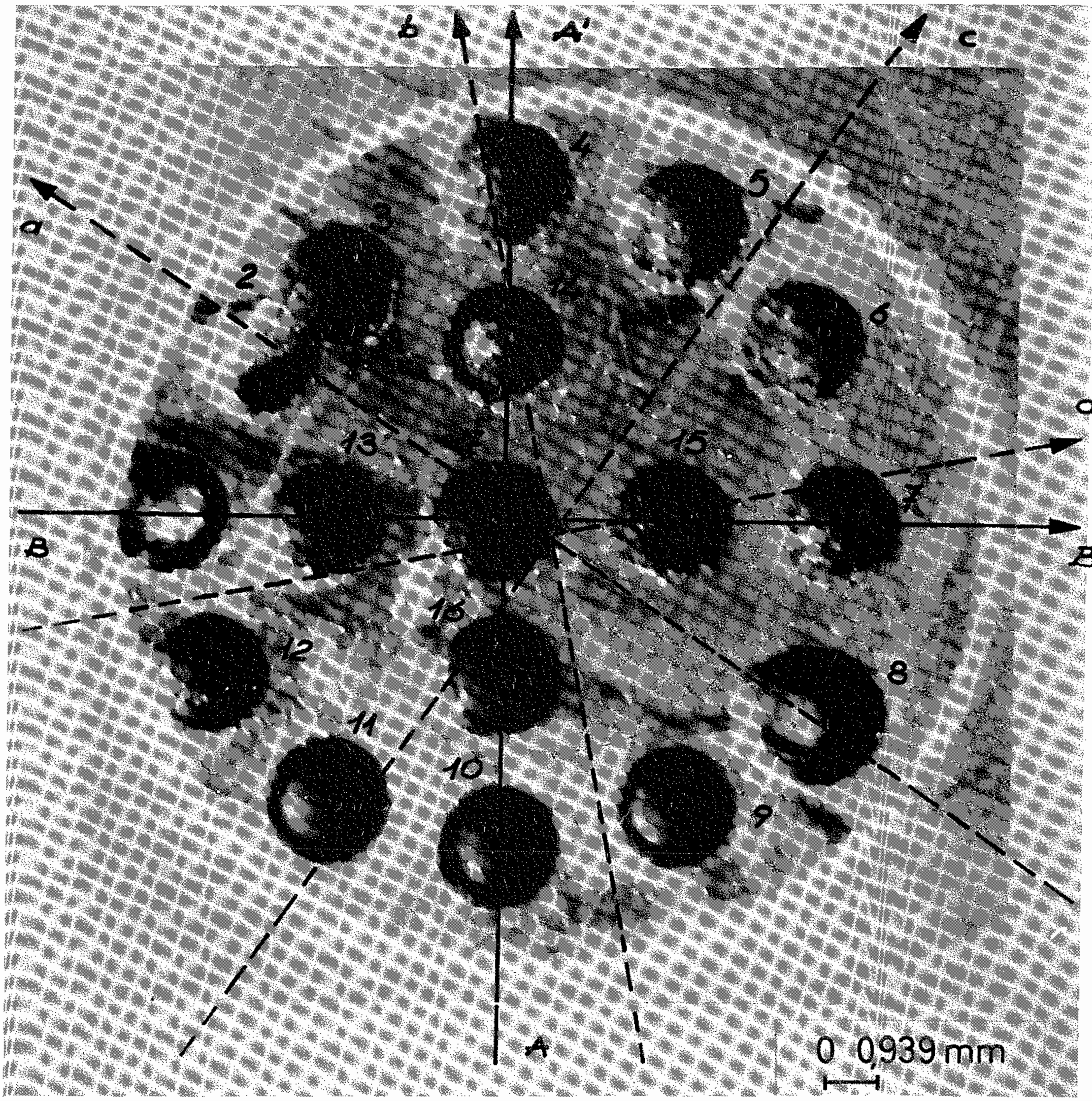
3. Drill probes, drilled and cored samples (Ø - 1.2 mm)



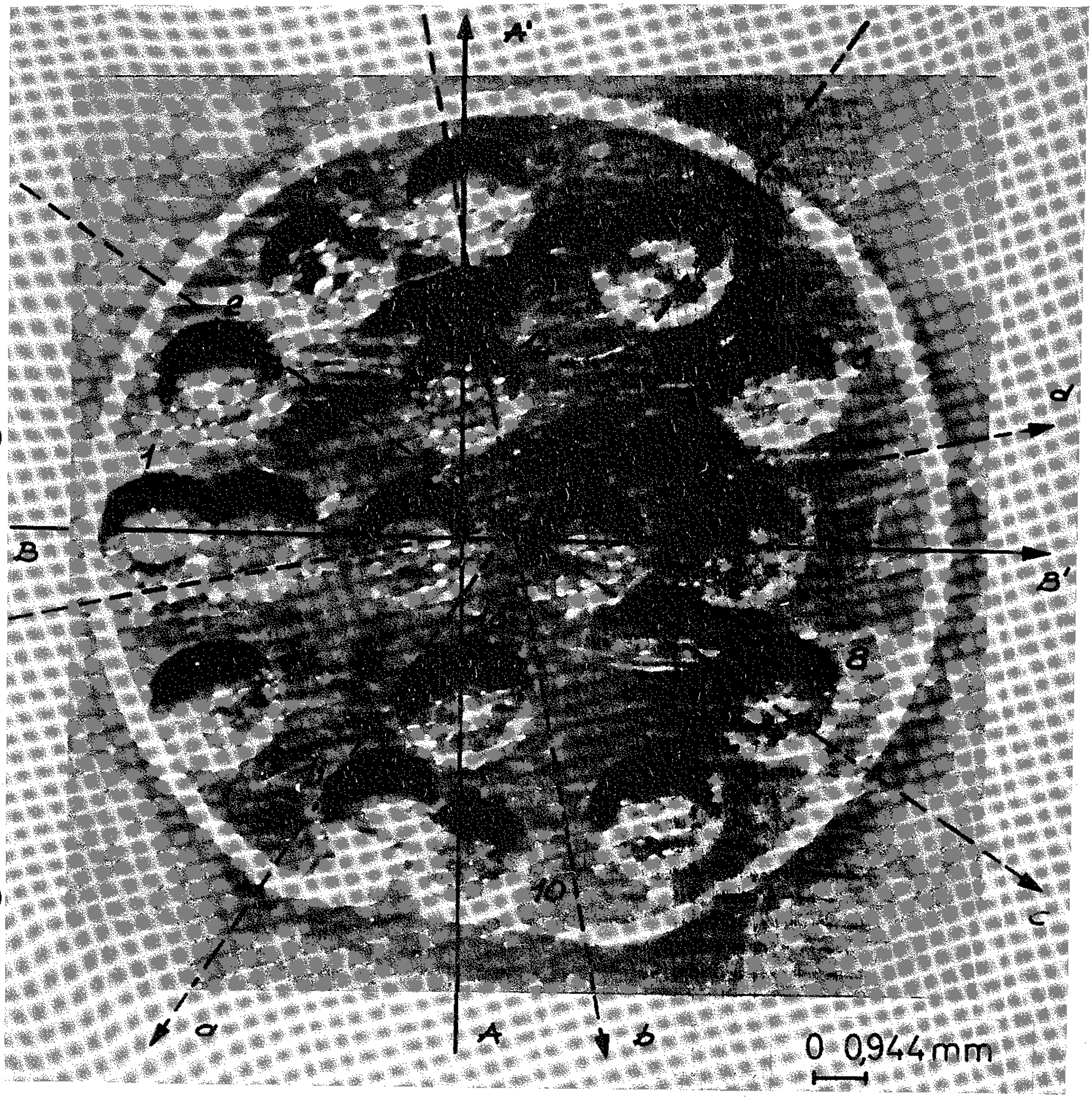
4. UO_2 sample ultrasonically drilled with cored samples
(Ø - 0.3 mm)



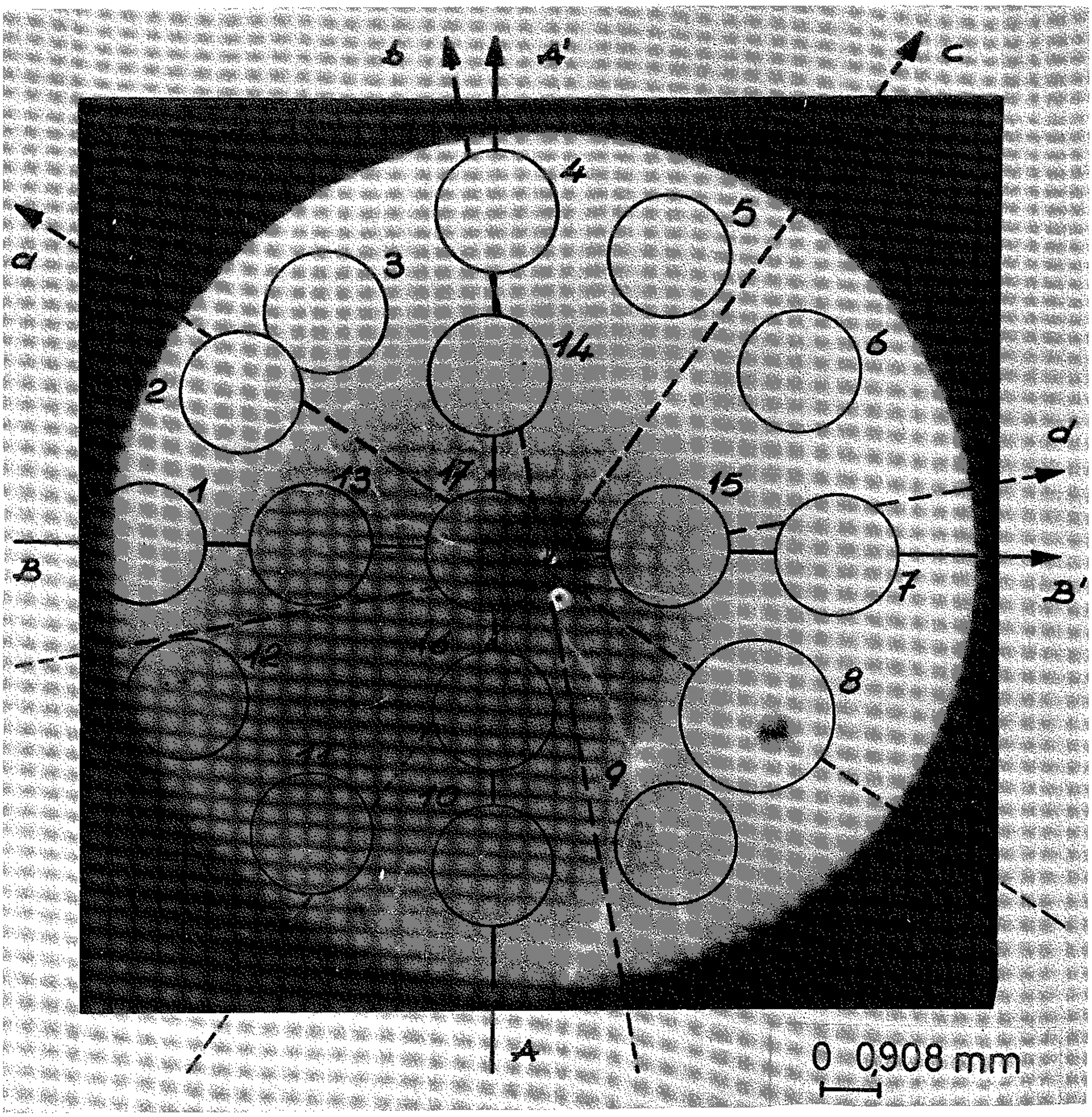
5. Cored samples (Ø – 0.3 mm)



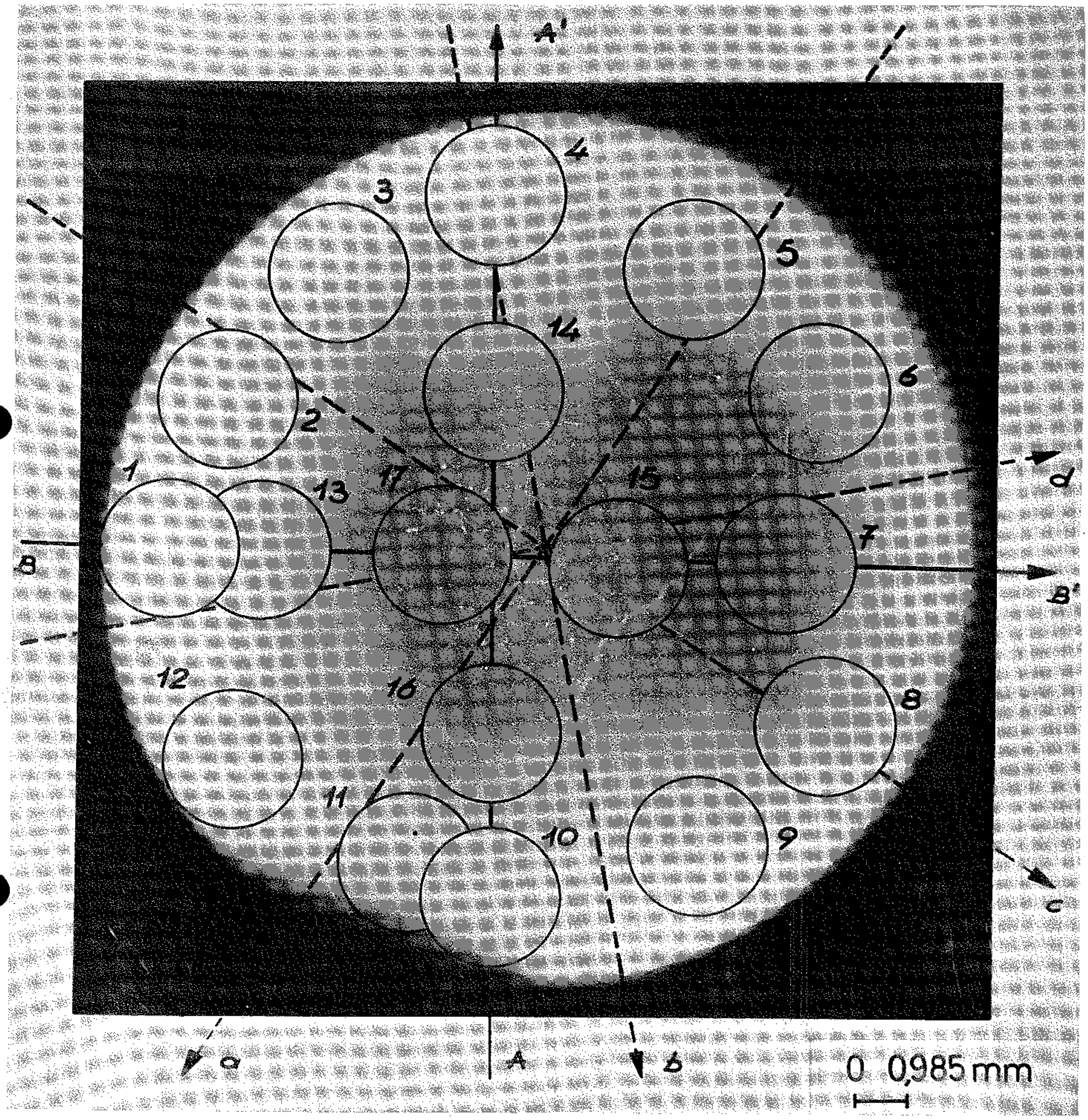
6. Macrophoto of an irradiated UO_2 drilled sample (taken through the periscope)



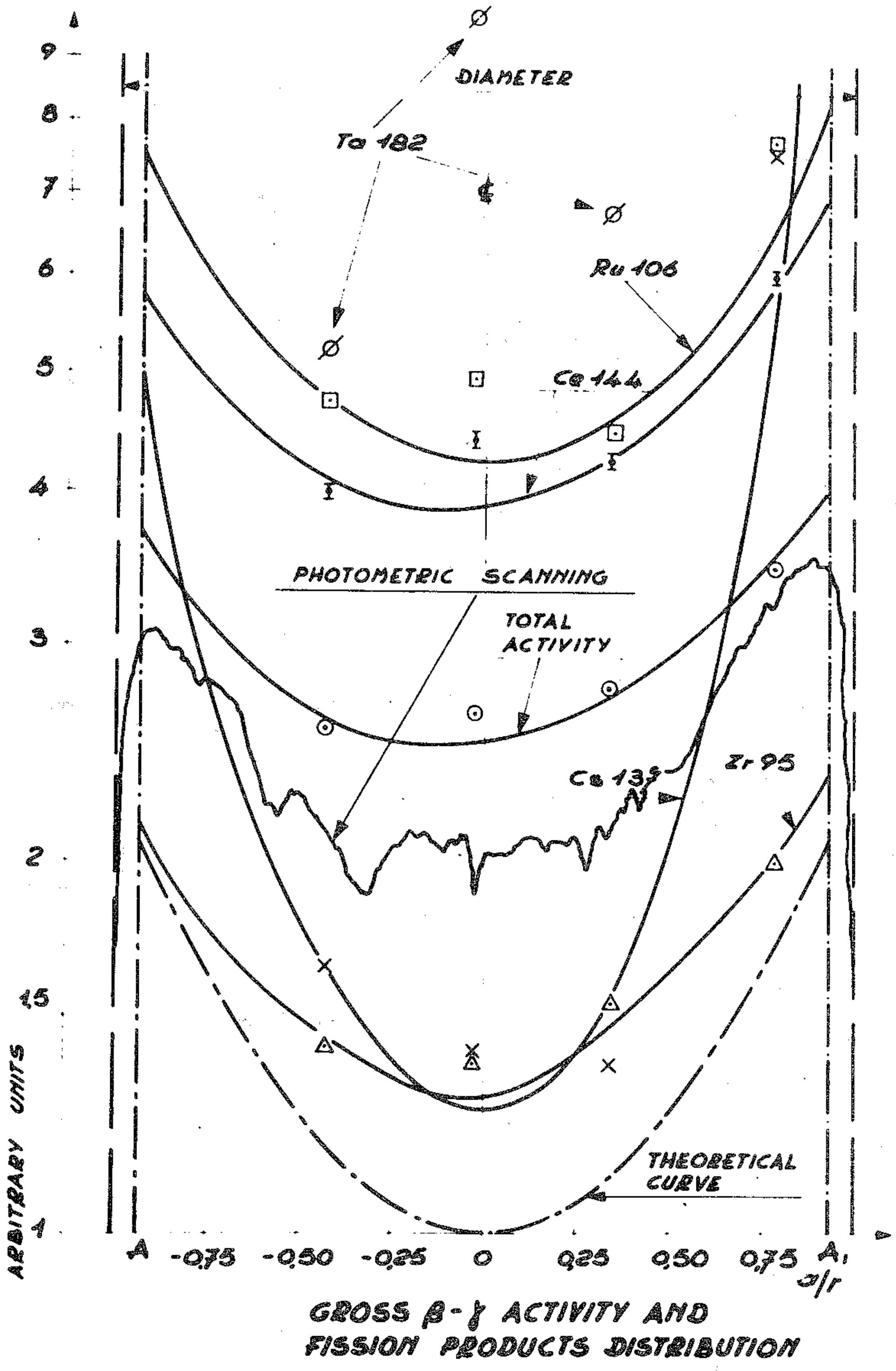
7. Macrophoto of an irradiated UO_2 drilled sample (taken through the periscope)



8. Beta-gamma autoradiography of an irradiated UO_2 sample with map of cored samples (before the drilling)



9. Beta-gamma autoradiography of an irradiated UO_2 sample with map of cored samples (before the drilling)



10. Gross beta-gamma activity and fission products distribution in a UO_2 drilled sample.