Scales for measurement of R_F values in paper and thin-layer chromatography

The R_F value of a component located on a paper chromatogram can be determined rapidly, without direct measurement of the distances travelled by solvent and component, using one of several simple aids devised for the purpose. In effect, each of these devices lays down a scale of one hundred arbitrary units between starting line and solvent front, and provides for the rapid and precise determination of the number of such units separating a component from its point of origin on the starting line of the chromatogram. This number of units is converted into the R_F value of the component by suitable location of the decimal point. R_F values of components on thin-layer chromatograms can be determined with these same devices, though the considerable patience and care required during their manipulation over the fragile surface of the adsorbent may preclude the use of several of them in this field, now one of major importance in analytical chemistry. The following brief review classifies the devices available for the measurement of R_F values, and their description offers a perspective from the point of view of their applicability to the thin-layer method. A new "R_F measure", which has proved suitable for use with both paper and thin-layer chromatograms, is also described.

The first R_F scale[1], consisting simply of a rubber strip inscribed with a scale dividing its length into ten equal units, has been developed further by SEGEL[2] (expansible scales are the subject of a patent[3]).

BERBALK[4] has described the use of a sliding wire potentiometer, part of a conventional circuit in which the millivoltmeter can be set by means of a variable resistance to read 100 mV for the length of wire corresponding to the distance travelled by the solvent front.

The other R_F scales which have been devised depend on the proportionality properties of similar triangles; the scales are either mechanically adjustable devices or inscribed transparent sheets. The former group includes the apparatus (Fig. 1) of JERCHEL, JACOBS AND MÖHLE[5], which can accommodate long distances of solvent flow apparently only at the expense of accuracy in the higher R_F values; other representatives of this group are the devices of SAVOIA[6] (Fig. 2), CLEMENTS[7] (Fig. 3; GLAZKO AND DILL[8] describe a similar device in which an arm moves across a transparent isosceles triangle, the arm being pivoted at the apex of the triangle, whose base is divided into ten equal units) and KOUDELA[9] (Fig. 4). Mechanical devices of these
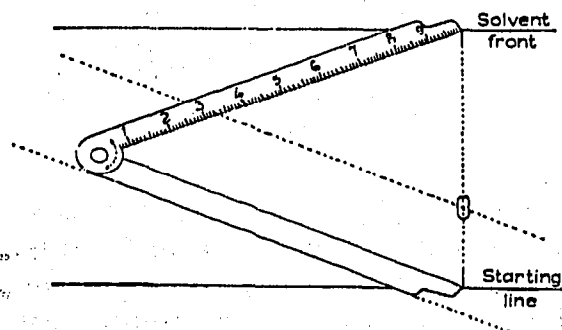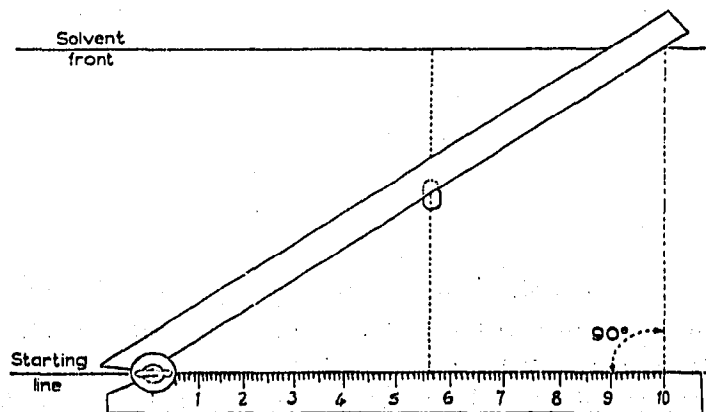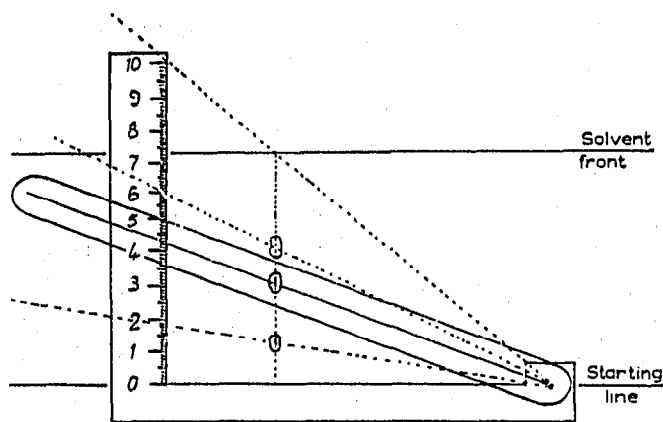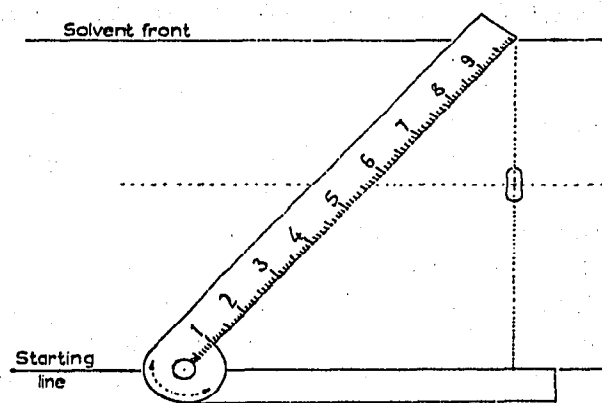

Fig. 1

Fig. 2

Fig. 3.

Fig. 4.

types are capable of adequate accuracy (though KOUDELA's scale is less satisfactory from this point of view), but are likely to be more or less destructive on thin-layer surfaces and cumbersome if constructed for use with relatively large chromatograms. Transparent scales embody considerable practical advantages, in the simplicity of their construction, in the ease of their alignment on a chromatogram, and in their applicability, without undue caution, to measurements on thin-layer chromatograms. They yield accurate R_F values, although ROCKLAND AND DUNN's "Partogrid"[10] (Fig. 5; HOTTA AND MORISHITA[11] describe a similar device) sacrifices this accuracy if constructed also to accommodate relatively short distances of solvent flow. A new device[12], the "R_F measure" (Fig. 6), does not suffer this disadvantage. NETTLETON AND MEFFERD[13] have described a modification of the "Partogrid" which enlarges the range of distances of solvent flow which can be accommodated conveniently by this device; these authors also propose[13] an R_F scale consisting of a transparent sheet inscribed with ten curves of common point origin, and state the mathematical derivation of this family of curves.
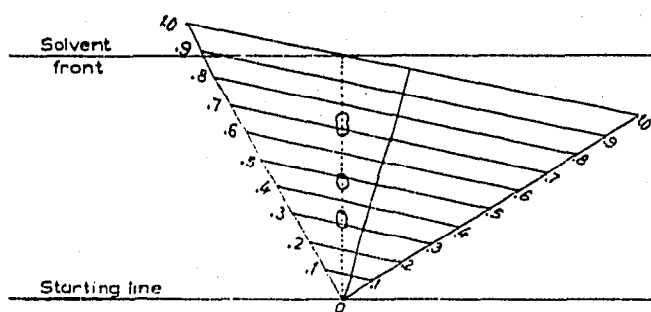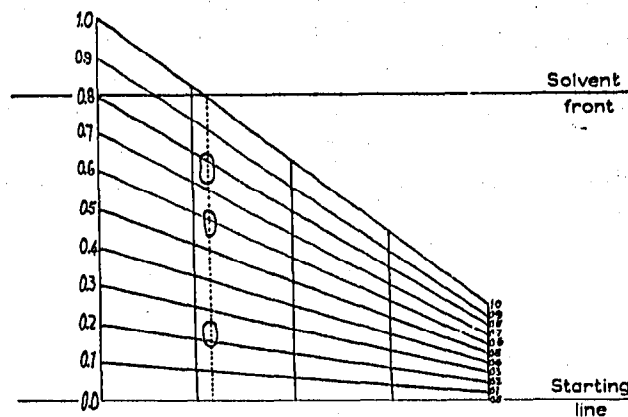

Fig. 5.

Fig. 6.

R_F values in both paper and thin-layer chromatography would be measured most satisfactorily with a development of BERBALK's potentiometer. An arm fixed to the sliding contact would be brought close to, but supported so as not to touch, the surface of the chromatogram; and accurate R_F values should thus be obtainable for long and short distances of solvent flow. Clearly, the nature of the application would

not normally warrant the cost of such a device, and a realistic selection of the best aid from this small field would be based on an assessment of other contenders for simplicity in construction and manipulation, for accuracy, and for compatibility with the thin-layer technique.

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Centrifugal chromatography

XIII. Centrifugal chromatography of cations*

A complete qualitative analysis of cations is usually a time-consuming operation. Nevertheless one very often needs extensive information about cations present in a given sample. In a laboratory that is arranged for inorganic analysis this is not a difficult task, because besides classical separation procedures with H_2S, other methods like flame photometry may be used. But in laboratories of a more biochemical character one always meets with difficulties in inorganic analysis. Recently POLLARD et al.[1,2] have published a systematic analysis of cations via paper chromatography that is very suitable for this purpose, but it has the disadvantage common to chromatographic separations that it takes a long time. The present paper shows how the chromatographic analysis of cations can be shortened by means of a centrifugal acceleration technique.

Experimental

For centrifugal paper chromatography the apparatus with central-spot development described by PAVLÍČEK et al.[3] was used.

Chromatographic separation was performed on Whatman No. 3 paper, the solvent system being *n*-butanol with 0.5 % benzoyl-acetone saturated with 0.1 N nitric acid.

The sample for analysis (if in the solid state) was dissolved or mixed (if it is in

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* For Part XII, see J. ROSMUS, M. PAVLÍČEK AND Z. DEYL, *Proc. Symp. Thin-Layer Chromatography, Rome, May, 1963.*