of solutes that, passing in succession along a rod or wire, are finally pyrolysed or volatilized for measurement. In connexion with column chromatography of liquids a variety of equipment for on-line quantitative determination is already available—at a price. Refractometric devices are deservedly, if somewhat belatedly, becoming popular, but will not supersede u.v. devices. Although the outlay (of the order of £500) for a u.v. device will not guarantee that meaningful values will be obtained for separated constituents, such a device at least has a valuable function as a monitor for detecting peaks, which may subsequently be examined off-line.

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Gas-Liquid Chromatography in Biochemical Analysis: a Review of Recent Trends in Equipment

By GEORGES GUIOCHON (*Laboratoire de Chimie Analytique Physique, École Polytechnique, 17 Rue Descartes, Paris 5, France*)

Although g.l.c. was invented by two biochemists, most people in this field have, until relatively recently, regarded this technique more as a snare than as a tool. The main reason is that, in spite of many papers by leading experts working with equipment of their own make, in spite of many advertisements for the 'new gas chromatograph X for biochemical analysis', most commercial equipment has been designed, often successfully, for the analysis of petroleum fractions. This situation is slowly changing, however, and analysis of many compounds of biochemical interest may now be carried out successfully on a routine basis.

It must be taken for granted that the conventional systems for pressure, flow-rate and temperature controls, signal recording and data acquisition and handling are working properly, since they are common to all kinds of chromatographs. Problems associated with sampling, column design and detectors will be discussed.

Many compounds of biochemical interest cannot be analysed as such because they are too polar and not volatile enough. The formation of suitable derivatives is often a good solution, and the various reagents and methods that can be used will be reviewed. Another solution, though much less frequently used, is pyrolysis g.l.c. Some examples of this will be given. The carbon-skeleton determinator will also be exemplified.

Column injection is not too difficult with conventional packed columns. It is much more of a problem with capillary columns, and various ways of solving this will be discussed, with emphasis on the direct injection of very diluted solutions.

Column packings have changed little during the last 10 years, although a few stationary phases that can be used in the 300–400°C range have been developed. A truly inert support is still to be obtained, but the art of chemical modification of solid surfaces by grafting is now fairly well advanced and can offer satisfactory solutions.

New detectors have been developed that have very high sensitivity and selectivity. The flame-photometric detector can determine separately compounds containing nitrogen, sulphur and phosphorus. The electron-capture detector is highly sensitive to halogens, though it is somewhat less predictable. The mass spectrometer is a very sensitive detector, and simultaneously offers a solution to a problem that is usually not solvable by g.l.c. alone, namely the identification of a truly unknown compound.

Finally, some recent examples of difficult analyses will be discussed, as well as the scope of the method. A few problems will be discussed in detail, this seeming to be more useful than a superficial review of the very abundant scientific and technical literature.

Equipment for High-Pressure Liquid Chromatography

By JOHN H. KNOX (*Department of Chemistry, University of Edinburgh, Edinburgh EH9 3JJ, U.K.*)

High-pressure liquid chromatography has developed within the last 5 years and has brought to liquid chromatography the speed, resolution, sensitivity and ease of operation previously associated with g.l.c. The technique promises to be of immense importance for clinical, forensic and biochemical analysis.

The essential features of a modern liquid chromatograph are: (a) a pressurization or pump system capable of delivering degassed dust-free solvent against back pressures up to 21 MN/m² (3000 lbf/in²) and at flow rates up to 10 cm³/min; (b) an injection system for placing samples of volume a few microlitres on the column head; (c) a column, generally 25–100 cm long × 2–4 mm diam., that is packed with 20–50 μm-diam. partitioning material and preferably thermostatically controlled; (d) a highly sensitive detector, of not more than 10 μl volume attached directly to the column outlet, that produces an electrical signal that can be processed by a recorder or other data-handling system.

Commercial equipment costs between £3000 and £10 000, depending on the 'sophistication' and versatility desired. Home-made equipment is cheaper but has its drawbacks. The expensive components in home-made equipment are the pressurization system or pump (£600–1000) and the detector (£600–1200). Couplings should be of the compression type, and all parts coming in contact with the eluent must be of