Fifty Years of the Hilger Spekker

R.H. Nuttall, University of Strathclyde, Glasgow

Introduction

In the years following World War II increasing levels of instrumentation were characteristic of chemistry laboratories worldwide. In this era a select few instruments came to be particularly associated with their areas of application, typical examples being provided by the Beckman DU for point-by-point UV-visible spectrophotometry; the Perkin-Elmer Model 21 for infrared spectroscopy; and though more restricted in its application, but with a very widespread body of users, the Hilger Spekker for colorimetric absorptiometry, particularly applied to metallurgical analysis.[1]

In the period extending from the early 1940s to the mid-1960s the Hilger Spekker photoelectric absorptiometer was virtually synonymous with the colorimetric determination of metals. In the United Kingdom at least, it was an important analytical instrument in virtually every laboratory associated with the ferrous and non-ferrous metallurgical industries. Its use was particularly widespread in the Scottish steel industry and as such it is now represented in the 20th-century instrument collection of the Royal Museum of Scotland in Edinburgh. It may seem curious that so recent an instrument should figure in a museum collection but it must be recalled that the rate of disappearance of instruments of the immediate post-war era has been extremely rapid. For the most part it has only been as a consequence of financial restrictions on their replacement that examples of instruments in use prior to 1960 survive to be collected to the extent that they do.

Early History

The prototype of the Spekker appeared in 1936, with the first two production instruments being delivered late in that year.[2] Surviving records suggest that 22 more were sold in 1937, mostly to laboratories in the British Isles but with examples going also to Strasbourg, Leningrad, Madras, Kuala Lumpur, and Batavia. The list of recipients, and the range of applications proposed in the earliest Hilger promotional literature, indicated that pathology, pH measurement and food and water testing were thought at first to represent the most important areas of application. Significantly, however, an early report from the Glaxo laboratories, reproduced by Hilger in their Spekker literature, included the estimation of iron by thiocyanate, and copper by thiocarbamate as examples of metallurgical analysis.[3] Moreover, in an early promotional exercise Hilger circulated information about the Spekker to every pathological laboratory in the United Kingdom, but by 1938 their selling agents were being advised that metallurgical laboratories were equally worthwhile target areas for sales.

Under the impetus of World War II, and particularly on the basis of E.J. Vaughan's work at the Admiralty Inspection Laboratory in Sheffield, the use of the Spekker for metal analysis spread with great rapidity.[4] The extent of this area of application was soon demonstrated in Haywood and Wood's textbook published by Hilger in 1944 (and in greatly expanded form in 1957).[5] The rapidity with which the Spekker attained a presence in the North American market is suggested by its inclusion as one of the few British instruments in Ralph Mueller's extensive compilation on chemical instrumentation which appeared in the Analytical Edition of *Chemical Engineering News* in 1941.[6]

At the time of its introduction the Spekker was seen as taking over the role of the visual colorimeter, primarily of the Duboscq type. However, there were other directly competing photoelectric colorimeters of which the Lange model was regarded by Hilger as the leader. Sales agents were accordingly carefully briefed as to the advantages of the Spekker by comparison with this instrument. Through the use of two of the newly-developed barrier-layer photocells, operating in a null mode, Hilger considered that they enjoyed a significant technical advantage over the competition[7]; and indeed though the detailed physical construction and also the various control features of the Spekker were significantly varied over the years, the fundamental mode of operation was not.

In all the Spekker absorptiometers a light source with a photocell on each side of it provided the basic means of operation. In one direction radiation from the lamp passes through the sample, then through a variable aperture (calibrated in optical density) and on to the "sample" photocell; in the opposite direction the light traverses an iris diaphragm on its way to the compensating photocell. Although initially there was some suggestion that the full output of the light source might be used for all types of measurement, optical filters in each beam were quickly found to increase both sensitivity and reproductibility. The method of operation was to set up the instrument with the solution to be measured in the "sample" light beam, and then balance the output EMF of the photocells to zero on a galvanometer. The sample was replaced with a reference cell, typically containing water, and the null point again obtained by reducing the light falling on the sample photocell by closing down the calibrated aperture. Variations of this technique were recommended for batch-type analyses involving large numbers of solutions.

Spekker Models

The importance of the Spekker was recognized from the outset as far as the Royal Museum of Scotland collection was concerned; though it was not at first realized that the evolution of the instrument had produced so many variations in physical appearance and in areas of application! Thus the prototype, in which all the components were set in a line on an elongated base, is now known only through a half-tone illustration in the *Journal of Scientific Instruments*.[8]

In the first production instruments (H454) a special base casting with a space for a galvanometer was introduced, and this feature remained in production for many years. The read-out drum was placed at the end of the instrument, however, in a position which rendered it prone to damage. By 1939 the drum had moved to a less vulnerable position closer to the lamp house and there thus appeared the long-lived H560 model. This development took place after the introduction of a version providing for long pathlength cells, intended for faintly absorbing solutions (H525). No example of either the H454, the H525, or the long-cell equivalent of the H560 — the H574 — is at present in a museum collection. In 1941 a micro-cell version appeared (H546) designed for biochemical work, and this made use of a more sensitive galvanometer, which was too large to sit on the instrument base. In the same year a fluorimeter modification (H553) was developed, with a mercury lamp as a light source, and transfer optics to allow comparison of right-angle fluorescent scattering from a series of solutions. (Again, at present, no examples of these two instruments are in museum collections.)

There was a major redesign of the Spekker in 1947 with the new version (H760) having a larger base plate, and a finned lamp housing.[9] Internally the calibrated diaphragm of the H560 was replaced by a rotating optical wedge. The long-pathlength version was the H675 while the fluorimeter version was initially supplied under the coding

H679 and later as H764. Production of these final versions continued until about 1968 and overall some 12,000 Spekkers were manufactured.[10] It is a measure of the importance attached to the instrument that its production was continued during the Second World War when much of the instrument-manufacturing capacity available in Britain was directed towards the production of military equipment and optical components. Evidently the requirement for means of quality control of steel and other metals for armament manufacture was seen as vital for the war effort, while the application of the fluorimeter for vitamin assay appears to have provided the justification for its war-time introduction and production. By 1945 these two Hilger products had established a significant market position and such instruments as the Unicam Colorimeter, production of which was restarted after the war's end, made comparatively small inroads into the UK market. The expansion of the analytical application of the Spekker in the steel industry, and the dominance it achieved — at least in Scotland — was further demonstrated by the formation of a Spekker Users Group which was meeting regularly in the early 1960s.[11]

Fate of the Spekker

The Spekker was usually used in association with the Hilger large quartz spectrograph in major metallurgical laboratories. Its use in this area gradually declined, however, with the spread of direct-reading spectrographs of the Polyvac type and with the introduction of atomic absorption methods. For biochemical applications the Spekker was supplanted by the introduction of the Biochem single-photocell absorptiometer; at first of the type constructed, as was the Spekker, on a substantial base casting, to be replaced in 1953 by the more familiar sheet-metal encased, brick-shaped version.[12] Instruments such as the Beckman DU UV-visible prism spectrophotometer could of course also be used for the same applications as the Spekker, as well as for point-by-point spectrum plotting. Demand for this type of instrument was in fact so great that it was at the request of the Ministry of Supply that Unicam introduced the SP500, and Hilger the Uvispek in an attempt to stem the drain on valuable dollars in the post-war austerity years.[13] However, while in 1950 the Spekker cost a little over £100, the SP500 was introduced at about £475, and thus catered for a significantly different market.

Hilger & Watts appear to have made no attempt to replace the Spekker directly — though a modernized form of the fluorimeter version was available by 1966. This omission is surprising given the commanding position it had achieved, and particularly in view of the success that relatively simple and inexpensive colorimeter-type instruments have continued to enjoy. In 1968 Hilger & Watts entered into a sales partnership with Sir Howard Grubb, Parsons Limited and at about this time production of the Spekker ceased. Its use continued for many years after this, though it now seems likely that the only surviving application may lie in school project work for which it is eminently suitable — if spare parts (notably light sources) can be obtained.

Somewhat confusingly the name Spekker (a registered trade name) has been applied to other instruments manufactured by Hilger: most notably to a prewar ultraviolet spectrophotometer which combined a quartz spectrograph with a double-beam photometer; there was also for many years a Spekker direct-vision Steeloscope, a prism instrument designed for visual survey of a spark source.[14]

In common with many of the instruments of the immediate post-war years, the majority of Spekkers have now been discarded and it is salutary to observe that with the exception of the London Science Museum, and more recently the Royal Museum of Scotland in Edinburgh, no attempt is being made to ensure the retention of a representative range of chemical instrumentation and apparatus of this formative era, of which the Spekker is so characteristic. At present the Royal Museum has collected approximately 500 items from the post-war period — ranging from Bunsen burners to NMR spectrometers — and is still seeking to obtain further material (including instruments, relevant documentation and printed items such as catalogues) for its reference and display collections before it is too late.

References

1. H.A. Laitinen & G.W. Ewing, eds., *A History of Analytical Chemistry* (Division of Analytical Chemistry of the American Chemical Society: Washington, DC, 1977) provides a general survey.

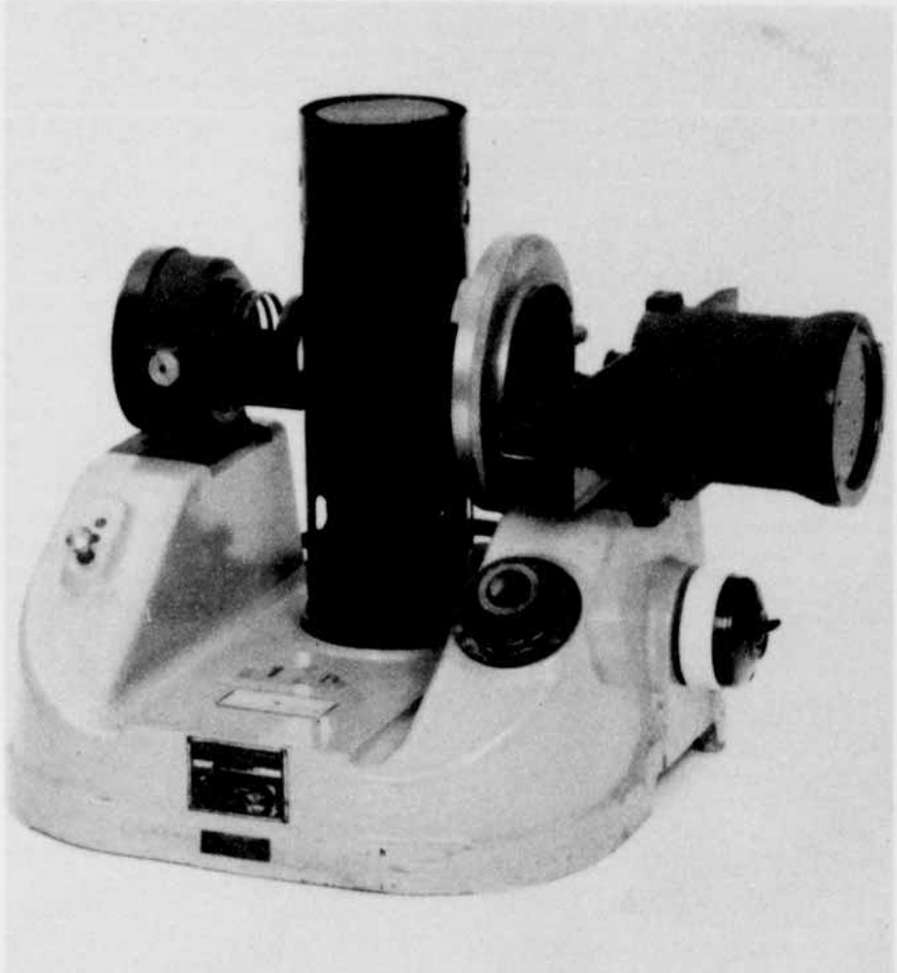

Fig. 1. *The H560 Spekker absorptiometer produced from 1939 to 1947. Royal Museum of Scotland, inv. no. 1986.248.*

2. Science Museum Library Archives. Hilger material HILG 1/7 and 2/8.
3. The Spekker Photoelectric Absorptiometer, an Objective "Colorimeter" (London, 1937). The Glaxo report is bound in with other Hilger promotional literature.
4. E.J. Vaughan, *The Use of the Spekker Photo-electric Absorptiometer in Metallurgical Analysis* (Institute of Chemistry: London, 1941).
5. F.W. Haywood & A.A.R. Wood, *Metallurgical Analysis by means of the Spekker Photoelectric Absorptiometer* (Adam Hilger: London, 1944 and 1957).
6. R.H. Mueller, "Instrumental Methods of Chemical Analysis", *Industrial and Engineering Chemistry*, Anal. Ed., **13**, 667-754 (1941).
7. Ref. 2, op.cit.
8. A. Hilger, "Photoelectric Absorptiometer", *Journal of Scientific Instruments*, **13**, 268-9 (1936).
9. The Hilger Spekker Photoelectric Absorptiometer and the Spekker Photoelectric Fluorimeter (London, 1947).
10. From Small Beginnings, a Century of Achievement (Margate, n.d.)
11. Personal knowledge.
12. G.E. Delory, *Photoelectric Methods in Clinical Biochemistry* (Hilger & Watts: London, 1949); with publisher's revisions (London, 1953).
13. Communication from Messrs. Pye-Unicam.
14. Communication from Messrs. Hilger Analytical.

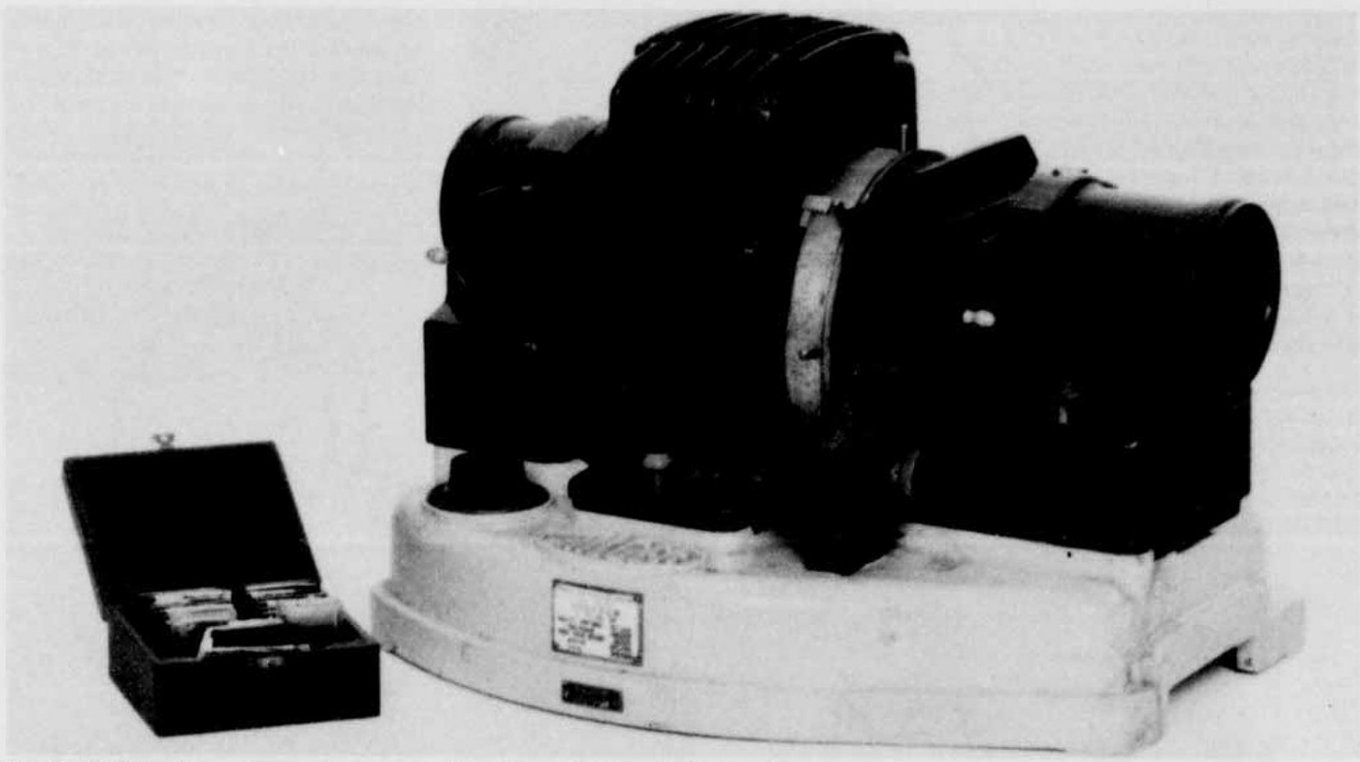

Fig. 2. *H760 Spekker absorptiometer produced from 1948 to 1968. Royal Museum of Scotland, inv. no. 1986.249.*

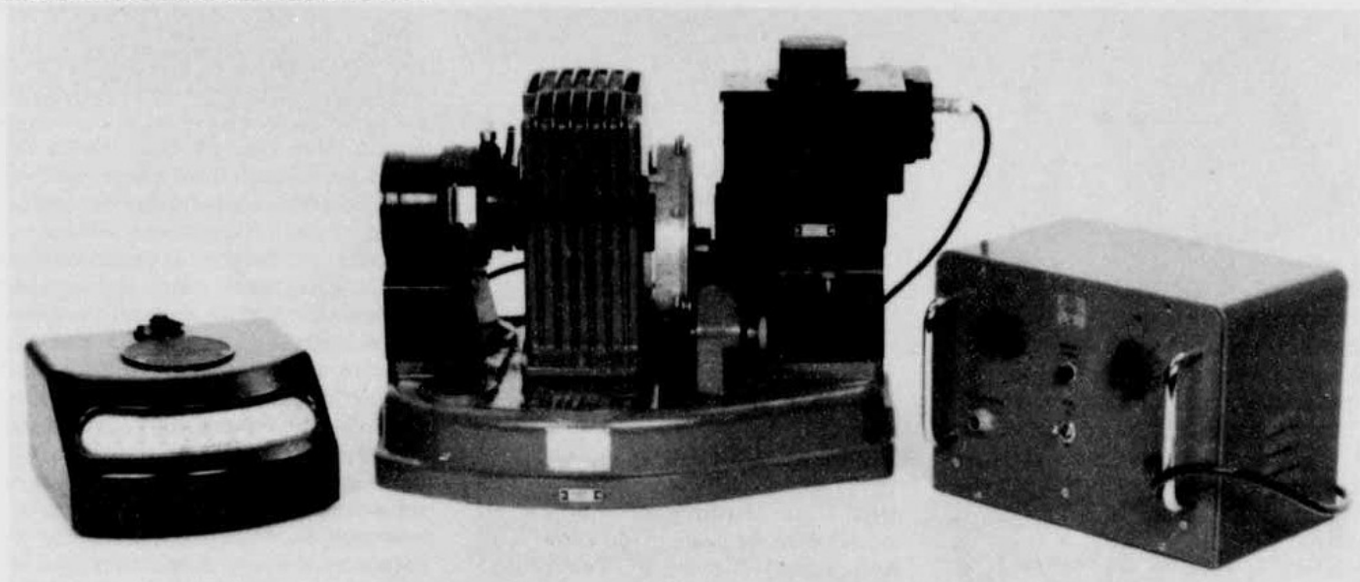

Fig. 3. *The second model of Hilger & Watts' fluorimeter produced from about 1950 to 1965. Royal Museum of Scotland, inv. no. 1986.162.*