PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

Introductory Remarks

G. W. Series

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Introductory remarks

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There can be few topics in experimental philosophy that, during the lifetime of this Society, have contributed more to the growth of science than have techniques in spectroscopy. For the beginnings we must look back to Newton's discovery of the dispersive power of glass prisms, a discovery that placed the prism at the centre of experimental spectroscopy for over 150 years.

Of course, the overlapping of the pinhole images of the Sun in the spectrum projected on to the wall of Newton's study prevented the resolution of solar absorption lines: these were first seen, I believe, by Wollaston in 1802, who used a slit instead of Newton's pinhole, and viewed the slit through the prism. But it was not until 1830 that a famous optician, Mr Simms, advanced spectroscopic technique by using lenses to form what we would now recognize as a line spectrum, projected on to a screen.

The establishment of spectroscopy as a quantitative science was not possible until some measurable characteristic of light could be disentangled from the dispersive properties of glass, and this, of course, came about with the invention of the diffraction grating. Fraunhofer's determinations of the wavelengths of solar absorption lines in the early 1820s depended not only on his gratings, but also on his use of beautifully engraved divided circles. He was able to measure angles of less than a degree with an accuracy better than parts in a thousand: he quotes the values to one-tenth of a second of arc. For his diffraction gratings, at first made by stretching wires between screws, the distances between the wires and the thicknesses of the wires were measured in units of 'Pariser Zoll'. Ångström, a few years later, worked in units of 10^{-7} mm. He referred to Fraunhofer's work and used the term 'pouce' instead of 'Zoll'. From values of the wavelengths of absorption lines given by Fraunhofer one finds that the conversion factor from 'Zoll' to centimetres is 2.7070, which is not inconsistent with the dictionary interpretations of 'Zoll' and 'pouce' as the German and French equivalents of the English inch. I take you back to this early work to remind you of the importance of the establishment and maintenance of base units of length (and, of course, also of time) in the context of spectroscopic technique. This topic finds its place in our programme.

Most of the papers we shall hear at this meeting owe their inclusion in a programme devoted to *new* spectroscopic techniques to the invention of lasers, and more particularly to tunable lasers, a development barely 10 years old. We are particularly fortunate in having with us Professor Schawlow, who will sum up the meeting at its conclusion, and whose share in the Nobel Prize for Physics this year for his part in the invention of lasers and for their applications in spectroscopy brought such pleasure to the international community represented here. There was indeed a temptation to those who conceived this meeting to centre it on 'applications of lasers to spectroscopy', but we preferred the more general title because recent years have seen, alongside the development of lasers for spectroscopic use, great advances in digital electronics applied to spectroscopy and advances also in the detection of extremely weak fluxes of radiation. There have also been developments in interferometric techniques, and in spectroscopic methods

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based on atomic coherences where lasers have been used, but are not of the essence. We are fortunate in having experts in these subjects among our speakers.

Many of you will be aware that there have been great advances in techniques also in regions of the spectrum not covered by this meeting; in the microwave region, on the one hand, and in the vacuum ultraviolet and X-ray regions on the other. It seemed to us that the inclusion of those regions would have extended the scope of the meeting beyond what could reasonably be accommodated within two days, but that within the visible and the nearer regions of the ultraviolet and infrared there was sufficient common ground for the establishment of a coherent programme. That is what the organizers of the meeting have tried to accomplish.

We have drawn on chemists, astronomers and physicists for our speakers. There is no hard and fast distinction between the programmes arranged for the two days, but I think you will find that principles are more to the fore today, and applications tomorrow. I am sure that we shall all learn a great deal and draw a great deal of inspiration through this sharing of experience between the different disciplines of physical science.

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