29. **Boundary Layer Profiles Made Visible by Means of Wilson Photograph of Alpha-rays.**

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A new method of directly photographing the velocity distribution curves in the air flow was invented and applied to the boundary layer investigation. It consists of C. T. R. Wilson's method of photographing the ionisation tracks of $\alpha$-rays emitted normally through the boundary layer of a moving object. Owing to the air flow induced by the motion the tracks suffer some distortion which reveals in a striking and concrete manner the velocity profiles.

![Fig. 1. The apparatus, plan view and central section of windows.](image)

The apparatus consists of three parts i.e. the cloud chamber proper ($A$), an expansion space ($B$) and a vacuum chamber ($C$), and is composed of two blocks of gun-metal castings which are clamped each other by eight strong bolts (see Fig. 1).

The chamber ($A$) is a fairly large square cylinder 30 cm. long, $13 \times 13$ cm$^2$. in section, through which an aerofoil model ($m$) runs being guided by a sliding rod ($r$) laid under the bottom of the chamber, while the latter is pulled from outside by a suitable mechanism.

The piston usually employed is here replaced by a rubber diaphragm ($d$) as recently suggested by Prof. Wilson,$^1$ so that the expansion space takes a lenticular form bounded by the diaphragm and a perforated brass plate ($p$) and its volume is adjusted by pumping air in.

The expansion is effected in sudden communication of the space ($B$) with the vacuum chamber ($C$) by opening the valve ($v$) which covers the hole of a thick rubber wall ($u$) between the two spaces. A special trigger mechanism ($t$) is employed for the maximum possible suddenness and ease of catching and releasing the valve.

The model aerofoil is of 4.5 cm. chord and 12 cm. span, and is provided with several narrow pits bored normally to the upper surface along

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the central section of the foil (their positions are as shown in Figs. 2 and 3). Platinum wires activated with polonium are inserted through the pits from underside and α-particles from polonium are incessantly ejected through the pits nearly normally (strictly normally if the α-ray sources were sufficiently strong and placed deep enough from the surface) to the surface.

The aerofoil starts from the position as shown with a broken line (m') in Fig. 1, and soon passes under the window (W) with a constant speed of a few meters per second.

A camera (c) is set upon the window with shutter open, and the
photograph is taken by a momentary illumination from an exploded tungsten wire \((s)\) through a side-window \((w)\) at short interval after the expansion. Starting of the model, chamber expansion and illumination are adjusted by a timing arrangement (not shown in Fig. 1) attached to the sliding rod.

Photographs thus obtained are reproduced in Fig. 2 and 3. As the sources are weak and placed too near to the surface, the tracks photographed are all of \(\alpha\)-particles emitted not strictly normally but inclined to the surface, however we can get a clear knowledge of the boundary layer and the order of its thickness. Spiral tracks seen in the wake vortices are due to \(\alpha\)-rays emitted before the expansion.

Fig. 4.

A similar photograph is shown in Fig. 4 which indicates random tracks of \(\alpha\)-rays emitted from the lower surface of another model. One which is seen in the middle part of the figure is of an \(\alpha\)-particle projected nearly normally to the surface and describes a boundary layer profile fairly satisfactorily.

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