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This Week's Citation Classic

May K R. The cascade impactor: an instrument for sampling coarse aerosols. *J. Sci. Instrum.* **22**:187-95, 1945. [Chemical Defence Establishment, Porton, England]

This instrument samples all airborne particulate material. Indrawn aerosol passes through progressively finer jets directed at glass slides. This subdivides the particles into size ranges whose relative mass characterises the fineness of the aerosol. Original techniques for identifying the particles are also described. [The *SCI*® indicates that this paper has been cited over 195 times since 1961.]

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"Development of this device was originally stimulated by the need to assess chemical warfare aerosols. These, according to their particle size, can attack through differing routes, e.g., skin, eyes, nasal mucosa, and lungs. I first attempted to simulate the particle capture processes within the respiratory system by drawing air, at the rate of a mildly exercised man, through an instrument in which, by an analogous process of inertial separation (i.e., impaction), the aerosol was divided into size ranges resembling those retained within the nostrils, the turbinals, the bronchi/bronchioles, and finally the lung. However, at that time (1942) knowledge of these size ranges was vague. In the impactor's final form the aerosol was sucked through four progressively finer slit-jets to impact the particles on glass slides, in the approximate size ranges of > 15, 15-4, 4-2, and 2-0.5 *μm.*

"Using a wind tunnel, the intake orifice was designed to give a high intake efficiency of particles. Ease of handling and compact size were important to enable considerable numbers of impactors to be deployed in the field.

"This new type of instrument demanded the development of new ways of retaining and detecting the tiny particles and droplets on glass surfaces. The techniques described in the paper have come into worldwide use. The paper also contains the first attempt at dimensional analysis *of* the impaction process, pointing the way to a reliable theory *of* the performance of jets of any size and flow rate. This aspect has stimulated a vigorous follow-up literature as a theoretical and experimental exercise in its own right.

"Originally, size distributions of the aerosols were obtained by counting and sizing individual particles or droplet imprints under the microscope, for which the eyepiece graticule described in the paper and later refined[1] is specially suitable. But this process is tedious and I realised, as also reported in the paper, that approximations to size-mass distribution curves for the whole sample could be obtained by measuring the mass of material on each stage (chemically, weighing, etc.) and then plotting the cumulative mass up to a given stage against some characteristic size for that stage. This simplification led to the commercial development of many designs of cascade impactor with up to ten stages to quantify and qualify specific aerosols (including microorganisms) in industrial and research applications.

"The foregoing explains the frequent citation of the paper, opening up, as it did, several new areas for research and environmental air studies. References to some of the later work in these areas are listed at the end of a recent paper[2] in which I described my ultimate thinking on cascade impactor design, before retirement. Another paper[3] contains a description of a simple modification to the 1945 instrument which almost eliminates intake loss of particles.

"Apart from its title, the 1945 paper introduced the terms 'impactor,' 'impaction,' and 'isokinetic sampling' into the literature."

1. **May K R**. A new graticule for particle counting and sizing. *J. Sci. Instrum.* **42**:500-1, 1965.
2. ..... An "ultimate" cascade impactor for aerosol assessment. *J. Aerosol Sci.* **6**:413-19, 1975.
3. **May K R, Pomeroy N P & Hibbs S.** Sampling techniques for large windborne particles. *J. Aerosol Sci.* **7**:53-69, 1976.