and retain 90 per cent of the specified contaminant carried into the equipment in the air. Separation in the range from 90 to 100 per cent encounters a range of difficulty from 1 to infinity, which is correctly indicated on the degree scale as advanced. There are occasions when the engineer must make this situation clear to the client who desires an effluent concentration that is an extremely small fraction of the inlet concentration.

It is of interest here that the *Decontamination Factor* (DF) of the Atomic Energy Commission is occasionally used as an index of air-cleaning equipment performance. It is the same dimensionless number as our *separation degree*.

V. Classification of Cleaning Processes

Air-cleaning equipment is generally classified according to its predominating features. The resulting simplified grouping of devices gives only an approximate indication of the forces and mechanisms operating in the cleaning process. A simplified classification used here is the following: (*1*) preparation (conditioning, activation, injection); (*2*) settling chambers (gravitational separators); (*3*) inertial separators (cyclones, centrifugal separators); (*4*) filters (dry or adhesive media); (*5*) electric precipitators; (*6*) liquid systems (washers or scrubbers); (*7*) combination systems.

TABLE 2

Classification of Air-Cleaning Forces and Mechanisms

Preparation actions or processes
- Conditioning of the air
  - Cooling and condensation
  - Humidification (especially for electric precipitators)
- Injection of treating materials
  - Gas or vapor injection
  - Liquid injection (spray, mist, or fog)
  - Solid particle injection (flocculation; sorption)
- Activation of particles
  - Sonic agglomeration
  - Particle charging (electric; frictional)

Separation forces or mechanisms
- Precipitation (gas-flow and deflection unnecessary)
  - Gravitational field (settling chambers)
  - Electrostatic field
  - Thermal field (chiefly sampling devices)
  - Diffusional field (concentration gradient)
- Deflection (differential momentum or inertia)
  - Linear flow (impingement; impaction)
  - Helical flow (stationary or rotary centrifugal)
- Filtration (gas-flow channel subdivision; deflection; diffusion)
  - Rigid medium (screen, fabric, porous solid)
  - Loose solid medium (packed bed or column)
  - Liquid medium (bubble column)

In view of the informative nature of a classification or arrangement of subject matter in any field, it is desirable also to examine the nature of cleaning processes, forces, or mechanisms by means of a classification that more nearly agrees with fundamental concepts (see Table 2).

The classification suggested here features the segregation of processes of *preparation* from those of *separation*. This is done for analytical reasons, and does not imply either the possibility or desirability, in practice, of sharply dividing operations of conditioning an aerodispersion from those of separating matter from the gas. The distinction between preparation and separation is made in order that requirements of both functions are fully considered in relation to them and that are met by the designer so far as practicable. Many failures can be traced to inadequate provisions for treating, conditioning, agitating, cooling, humidifying, charging, or otherwise preparing the air and its contaminants for collecting or separating processes.

The three subdivisions of preparation are shown in the classification; each characterizes a general approach, comprising many techniques now in use: (*1*) conditioning the gas, (*2*) injection of additives, and (*3*) activation of suspensoids.

The processes of separating matter from a gas have been arranged in three groups according to the manner of handling the gas: (*1*) The category of *deflection* represents the view that separation is the result of differentially curved paths of the carrier gas and the separated particle, causing differential inertia or momentum. (*2*) The category of *precipitation*, or nondeflection, does not depend upon curvilinear path to accomplish separation; it considers the path of the carrier gas to be linear; separation is the result of forces generated externally, rather than by deflection of the gas. (*3*) The category of *filtration* represents the mechanical provisions for adjustment of channel size and configuration to activate to advantage of particle energies. It recognizes that effective filtration calls for the best balance between the several processes that occur simultaneously, namely, between centrifugal migration and molecular diffusion.

It is well to note that separation and preparation functions are simultaneous to certain extent. A good example is the so-called single-stage electric precipitator in which the particles are charged and precipitated in the same unit, although in fractional way along the air-flow path. It is true, however, that many advantages accrue from the practice of arranging the installation in separate units, each of which has a specialized share of the entire job of air cleaning.

In the desire to improve the performance of an air-cleaning system, it is well to analyze all units or stages of a combination system from the viewpoint of their potentialities as preparation devices, in addition to their essential functions as separation devices. The sequence of stages can be arranged so that each may accomplish an objective of preparation in the interest of better separation in succeeding stages.