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LETTER TO THE EDITOR

Use of the Word "Influx" in Palaeolimnological Studies

The word influx is often used imprecisely by paleolimnologists, especially in connection with pollen analysis studies. Ambiguity often arises when the word influx is used to describe a number of physical quantities which are actually quite distinct. The recent increase in interest in the variation and distribution of sediment within lake and peat basins (e.g., Davis *et al.*, 1971, 1973; Lehman, 1975; Bloemendal *et al.*, in press) has emphasized the need for clarity and precision in the terminology associated with sediment and pollen influx. Colinvaux (1978) has correctly drawn attention to the problems and difficulties encountered in calculating accurate accumulation rates of recent sediments and to the nuances of the word absolute. The use of the word influx raises an even more fundamental problem as it involves the dimensions of the measurements we are describing rather than their precision or accuracy.

It is convenient to discuss the word flux before considering the word influx. Flux is a clearly defined term which is used in several branches of physics (Thewlis, 1973). In nonmathematical terms the flux of a physical entity is the amount passing through a given area in unit time. Furthermore, flux density is defined as the flux per unit of cross-sectional area (Thewlis, 1973). For example, in fluid dynamics, the mass flux passing through a pipe is the integral over the cross-sectional area of the pipe of ρv, where ρ is the fluid density and v the fluid velocity. So in order to quantify the mass flux, or mass per unit time, in this example of fluid flow through a pipe, we need to know the relevant area, average velocity, and fluid density. Similarly, to calculate the flux of pollen grains into the sediment of a lake we need to know the area of the lake, the average sediment accumulation rate, and the average concentration of pollen grains in the sediment.

Influx is not a term commonly encountered in physics but may be defined as the integral of a flux over a time interval. [Sim-

TABLE 1. SUMMARY OF PALEOLIMNOLOGICAL TERMS ASSOCIATED WITH THE WORD INFLUX

Physical quantity	Velocity field	Sediment accumulation		Pollen	Proposed paleolimnological term
		Volume	Mass		
Flux[a]	$m^3\ sec^{-1}$	$m^3\ yr^{-1}$	$kg\ yr^{-1}$	grains per yr	Flux
Flux density	$msec^{-1}$	$m\ yr^{-1}$	$kg\ m^{-2}\ yr^{-1}$	grains per square meter per yr	Accumulation rate[c]
Fluence	m	m	$kg\ m^{-2}$	grains per square meter	Influx per square meter
Influx[b]	m^3	m^3	kg	grains	Influx

[a] The flux through a surface is the integral over the surface of the normal component of the flux density.

[b] An influx across a surface during a given time interval is the integral over the time interval of the flux through the surface. A sediment influx is measured as a volume or mass accumulated during a particular time interval and over a particular surface area.

[c] In some circumstances, e.g., reedswamp environments, it may be convenient to distinguish between autochthonous accumulation rate and detrital deposition rate or to define more precisely the material to which the term accumulation rate applies.

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ilarly fluence is defined as the time integral of a flux density (Thewlis, 1973).] Influx may be described by a volume, mass, or number of particles (e.g., pollen grains) but in all cases the relevant area and time interval must also always be specified. The phrase "pollen influx" is frequently used imprecisely to describe the number of pollen grains which have accumulated per square centimeter per year. This quantity is flux density and should be distinguished from an influx. Distinction is simply and precisely achieved (Table 1, line 2) by retaining the phrase "pollen accumulation rate" as used in the pioneering paper of Davis and Deevey (1964). The correspondence of the proposed paleolimnological terms to the formal terms associated with flux is summarized in Table 1.

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R. THOMPSON
Department of Geophysics
The University of Edinburgh
Edinburgh, Scotland