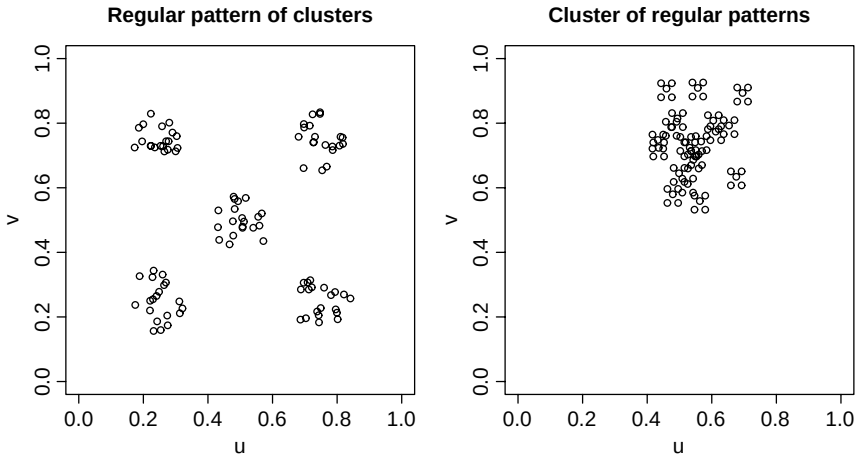

FIG. 5.3 Realizations of two hypothetical spatial point processes containing both clustering and regularity at different spatial scales.

and diseases in plants and animals (see, e.g., Turner et al. 1989; Levin 1992), but little appears to date in the epidemiologic literature [but see Prince et al. (2001) for an example].

With a general notion of clustered, random, and regular patterns (and an appreciation to the limitations of the simple categorization illustrated in Figure 5.3) we next seek to define probabilistic models of spatial patterns in order to motivate methods for detecting clustering among health events.

5.2 SPATIAL POINT PROCESSES

A *stochastic process* is a probabilistic model defined by a collection of random variables, say $\{X_1, X_2, \ldots, X_N\}$. In most cases each X_i is a similar measurement occurring at a different time or place (e.g., the number of persons in a post office queue at the ith time period, or the amount of rainfall at the ith location). A *spatial point process* describes a stochastic process where each random variable represents the location of an event in space. A *realization* of the process is a collection of locations generated under the spatial point process model; that is, a realization represents a data set resulting from a particular model (either observed or simulated). The patterns illustrated in Figures 5.1–5.3 display realizations from various spatial point process models. In some instances, a data set may consist of a sample from a realization of a particular pattern (e.g., we may map a simple random sample of residential locations of disease cases in a registry), and in such cases we must take care to consider the spatial impact (if any) of the sampling procedure (cf. Diggle 1983, Chapter 3).

Ripley (1981, Chapter 8), Diggle (1983), and Cressie (1993, Chapter 8) provide details regarding theory and applications of spatial point processes from many