for terrestrial insects. Body odor of plants and insects plays an important role in nature.

In interaction 1 (Fig. 5.6) herbivores are attracted to the host plant by volatile chemicals, and parasitoids may respond to similar compounds (interaction 16), as in Fig. 5.5. But toxic chemicals acquired from the host plant by the herbivore may be effective as defense against enemies (interaction 13). For example, Campbell and Duffey (1979) showed that increased tomatine levels in tomato plants were more deleterious to the parasitoid *Hyposoter exiguae* than to its host, *Heleothis zea,* feeding on tomato (interaction 3 was less potent than interaction 13). But when toxic chemicals are sequestered by parasitoids, as in the *Zenillia* species mentioned above, they become effective defenses against the fourth trophic level (interaction 26). As we will see later (Chapter 22), associated plants may interfere with host finding by herbivores (interaction 2) and by enemies of herbivores (interaction 19). All interactions in Fig. 5.6 are explained fully with examples in Price (1981a).

Physical characteristics of plants also mediate the herbivore–enemy interaction (Price et al., 1980). For example, trichomes on leaves may slow the searching rate of predators and parasitoids to the point where enemies become ineffective. Galls that grow relatively large provide more protection against the herbivores' enemies than do smaller galls, and galls with extrafloral nectaries attract foraging ants which interfere with attack by parasitic wasps (Washburn, 1984).

MONOPHAGY AND POLYPHAGY

If it is so advantageous to specialize in feeding on toxic plants, why are some species **monophagous** (feeding on one species of food) and others **polyphagous** (feeding on many species of food)? Also, why do some species feed on apparently innocuous hosts? There are many solutions to any given problem in nature and the evolutionary process ensures that many possible avenues are tested (Bernays and Chapman, 1994). Some species have never had the evolutionary chance to crack potent plant defenses because the gene pool has not produced the necessary combination of enzymes. Others have evolved to specialize by dealing with a few potent plant chemicals. Yet others evolved to generalize by utilization of many less toxic plants. These seem to be the two basic alternatives and both require quite an expensive metabolic commitment on the part of the insect. The monophagous species must produce large quantities of an enzyme to detoxify their food, or they must evolve storage mechanisms, as in the case of diprionid sawfly larvae. Conversely, Krieger et al. (1971) have shown that the polyphagous species of insects usually produce much more of the microsomal mixed-function oxidases in their midguts to deal with the very diverse array of plant chemicals in their potential diet.

Regarding the search for food, the monophagous species will have to search harder, but it can become highly specialized in its search and it has