once in generating a structure. For example, we can have one prepositional phrase describing location (*on the table*) in the sentence *The gun was on the table*. We can also repeat this type of phrase, using different words (*near the window*), for as long as the sentence still makes sense (*in the bedroom*). So, in order to generate a sentence such as *The gun was on the table near the window in the bedroom*, we must be able to repeat the rule that creates a prepositional phrase over and over again.

We must also be able to put sentences inside other sentences. For example, when we produce a sentence such as *Cathy knew that Mary helped George*, we do so with the sentence *Mary helped George* inside it. And those two sentences can be generated inside another sentence such as *John believed that Cathy knew that Mary helped George*. In principle, there is no end to the recursion that would produce ever longer versions of complex sentences with this structure.

Basically, the grammar will have to capture the fact that a sentence can have another sentence inside it or that a phrase can be repeated as often as required. We should note that recursion of this type is not only a feature of grammar, but can also be an essential part of a theory of cosmic structure, as in the role of turtles in one little old lady's view of the universe (in the introductory quotation).

Tree diagrams

One of the most common ways to create a visual representation of syntactic structure is through **tree diagrams**. We can use the symbols introduced in Chapter 7 (Art = article, N = noun, NP = noun phrase) to label parts of the tree as we try to capture the hierarchical organization of those parts in the underlying structure of phrases and sentences. So, we can take the information in a labeled and bracketed format, shown on the left, and present it in a tree diagram, shown on the right.

Although this kind of "tree," with its "branches," shown on the right, seems to grow down rather than up, it functions rather well as a diagram representing all the grammatical information found in the other analysis on the left. It also shows very explicitly that there are different levels in the analysis. That is, there is a level of analysis at which a constituent such as NP is represented and a different, lower, level at

Figure 8.1

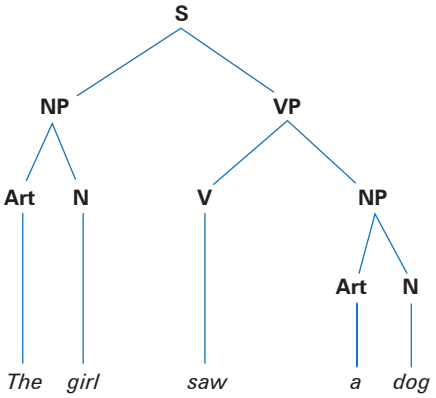

Figure 8.2

which a constituent such as N is represented. This type of hierarchical organization can be illustrated in a tree diagram for a whole sentence, beginning at the top with S.

If we start at the top of the tree diagram, we begin with a sentence (S) and divide it into two constituents (NP and VP). In turn, the NP constituent is divided into two other constituents (Art and N). Finally, one word is selected that fits the label Art (*the*) and another that fits N (*girl*). You can go through the same procedure with the VP branches.

Symbols used in syntactic analysis

We have already encountered some symbols that are used as abbreviations for syntactic categories. Examples are "S" (= sentence), "NP" (= noun phrase), "N" (= noun), "Art" (= article), "V" (= verb) and "VP" (= verb phrase). Others, such as "PP" (= prepositional phrase), seem fairly transparent. There are three more symbols that are commonly used in syntactic description.

The first is in the form of an arrow →. It can be interpreted as "consists of" or "rewrites as." It is typically used in the following type of rule:

NP → Art N

This is simply a shorthand way of saying that a noun phrase (NP) such as *the dog* consists of or rewrites as (→) an article (Art) *the* and a noun (N) *dog*.

The second symbol is a pair of round brackets **( )**. Whatever occurs inside these round brackets will be treated as an optional constituent. For example, we can describe something as *the dog* or *the small dog*. We can say that both *the dog* and *the small dog* are examples of the category noun phrase (NP). When we want to use a noun phrase in