undergo differentiation and organization even after extended culture in the undifferentiated state. The capacity to regenerate whole plants from undifferentiated cells under appropriate environmental conditions is called *totipotency*. This capacity is essential to plant micropropagation and is often associated with secondary metabolite formation. If we could do the same for animals as we can for many plants, we could remove a cell from the reader's tongue and generate millions of nearly identical clones of the reader's whole body!

Let us begin by considering the establishment of cell cultures for producing a particular chemical (see Fig. 13.2). *Callus* and *suspension cultures* have been established from hundreds of different plants. A *callus* can be formed from any portion of the whole plant containing dividing cells (Fig. 13.3). The excised plant material is placed on solidified medium containing nutrients and hormones that promote rapid cell differentiation. The callus that forms can be quite large (> 1 cm across and high) and has no organized structure. Although we speak of a callus as being *dedifferentiated tissue*, it contains a mixture of cell types. The sources of the initial tissue (root, shoot, and so on) can make some difference as well. If we are interested in maximizing the formation of a particular compound, it is advisable to initiate the callus from a plant that is known to be a high producer. Even from the same batch of seeds, there may be considerable variation from plant to plant in their biosynthetic capacity.

For both callus and suspension cultures, a chemically defined medium is used. Typically, cultures, especially suspension cultures, are maintained in the dark. While exposure to light may be used to regulate expression of specific pathways, light is rarely used solely to support growth as most cells are incapable of sustained photoautotrophic growth.

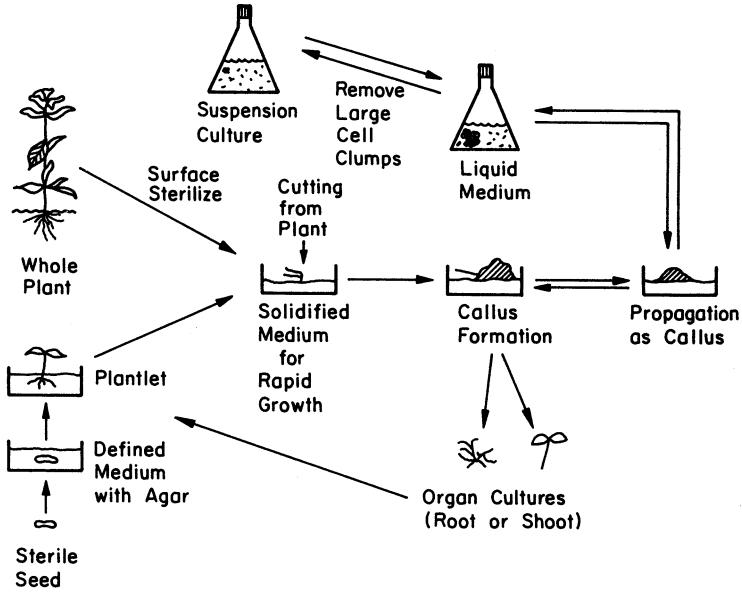

Figure 13.2. Suspension cultures can be established from many plants using this approach. For some plants, the process can be reversed to generate whole plants from suspensions.