roots as far back as the Muslim scholar Ibn Khaldun in the 14th century, and much later to John Maynard Keynes. Figure 5.2 shows the characteristic shape of the curve. The vertical axis gives the collected tax revenue as a function of the income tax rate. At rates above a certain value, the revenue decreases. The implication is that to the right of the maximum in the curve, a reduced tax rate will increase the incentive for people to work and therefore increase the total collected tax.

This is a highly idealized scenario that has been much criticized. It is trivial to understand that the curve starts at zero, but it is not evident that it should also end at zero for a 100 % tax rate. If the curve shows the marginal tax, it is only the top part of the income that is taxed according to the graph. One could imagine a society where there is a highest allowed income. Work beyond that is in some sense voluntary, and the society keeps all the revenue. In the real world there can also be several ways of tax evasion. Further, above a certain income level benefits can be given in nonmonetary forms that are not subject to tax.

In spite of all the criticisms of the Laffer curve when it is taken too literally as a model of taxation, it nicely illustrates a mode of thinking that is highly relevant far outside the field of economics – in physical sciences, engineering, biology, and elsewhere. The basic idea is that at the extreme ends of a certain phenomenon, the "effect" may be small or zero, for more or less obvious reasons. Between these ends there is a maximum, or optimum. Moving somewhat to either side of such an extremum does not significantly change the value of the effect. It is a merely a *second-order correction.*

As an application of this mode of thinking, consider traffic flow, for instance on a German autobahn (highway), where there are no speed limits. If the speed of the cars is zero, the flow rate (the number of vehicles passing per hour) is of course zero. One might naively think that the higher the speed, the larger the flow rate. Double speed would give double flow rate. But stopping distance increases as the square of the speed. Therefore, the distance between cars must increase more rapidly than the speed itself if road safety is main-

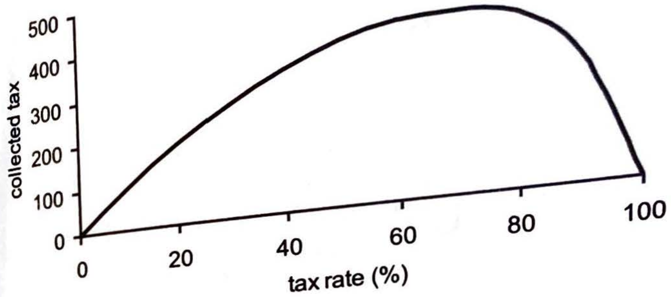

Fig. 5.2. The Laffer curve (schematic)

tained. It turns out that in a broad range of intermediate densities (around 30 vehicles per kilometer) and a speed of about 50 km/h (30 mile/h), the flow rate has a maximum around 1500 vehicles per hour. This is the ideal behavior, but our model ignores the familiar instabilities that can cause a traffic standstill for no apparent reason. It also ignores reckless driving at high speed.

Biology is full of examples where the Laffer type of curve provides a crude basis for the thinking. The male peacock displays his feathers in order to attract the females. If the feathers are small, he will not look impressive, but if they are too large, there will be obvious disadvantages. As another example, some migrating birds return each spring from Africa to northern Europe to breed. If they come early, they may secure a good territory, but then they also suffer the risk of succumbing to a last spell of cold winter weather. The peacock's feather size and the arrival date of the migrating birds can vary within a range of almost equally good alternatives, in agreement with the shape of the Laffer curve.

Running to the Rescue

When introductory physics books discuss the refraction of light at the boundary between air and water, or between air and glass, it is not unusual to make an analogy to the following kind of problem. You are standing at point A on a beach, when you see a screaming