Salviati: All the difficulties and objections you advance are so well founded that I deem it impossible to remove them. For my part, I grant them all, as I believe our Author would also concede them. I admit that the conclusions demonstrated so in the abstract are altered in the concrete, and are so falsified that horizontal [motion] is not equable; nor does natural acceleration occur [exactly] in the ratio assumed; nor is the line of the projectile parabolic, and so on. But on the other hand, I ask you not to reject in our Author what other very great men have assumed, despite its falsity. The authority of Archimedes alone should satisfy everyone....

Here I add that we may say that Archimedes and others imagined themselves, in their theorizing, to be situated at infinite distance from the center. In that case their said assumptions would not be false, and hence their conclusions were drawn with absolute proof. Then if we wish later to put to use, for a finite distance [from the center], these conclusions proved by supposing immense remoteness [therefrom] we must remove from the demonstrated truth whatever is significant in [the fact that] our distance from the center is not really infinite, though it is such that it can be called immense in comparison with the devices employed by us.... And these shots coming to end on the surface of the terrestrial globe may alter in shape only insensibly, whereas that shape is conceded to be enormously transformed in going to end at the center....

Also that motion in the horizontal plane, all obstacles being removed, ought to be equable and perpetual; but it will be altered by the air, and finally stopped.

Salviati: Next, a more considerable disturbance arises from the impediment of the medium; by reason of its multiple varieties, this is incapable of being subjected to firm rules, understood, and made into science. Considering merely the impediment that the air makes to the motions in question here, it will be found to disturb them all in an infinitude of ways, according to the infinitely many ways that the shapes of moveables vary, and their heaviness, and their speeds. As to speed, the greater this is, the greater will be the opposition made to it by the air, which will also impede bodies the more, the less heavy they are....

No firm science can be given of such events [*accidenti*] of heaviness, speeds, and shape, which are variable in infinitely many ways. Here to deal with such matters scientifically, it is necessary to abstract away from them. We must find and demonstrate conclusions abstracted from the impediments, in order to make use of them in practice under those limitations that experience will teach us.... Indeed, in projectiles that we find practicable, which are those of heavy material and spherical shape, ... the deviations from exact parabolic paths will be quite insensible.

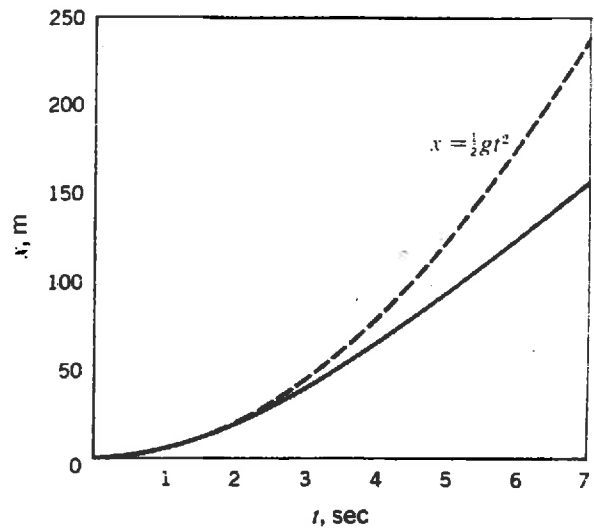$r = 1$ cm

$m = 10$ gm

(a)
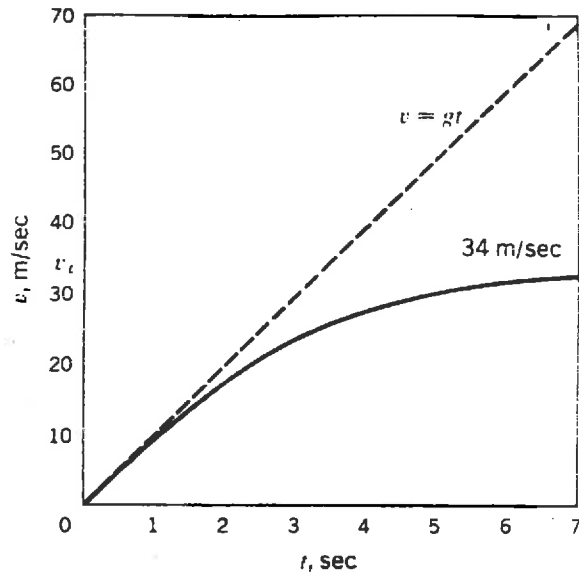
(b)

Fig. 7–22 (a) Comparison of idealized (resistanceless) and actual dependence of speed on time for a falling pebble of radius 1 cm. (b) Idealized and actual distances fallen by such a pebble.

$$resistance\ decel\ of\ spheres \propto \frac{velocity^2}{radius \times density}$$

from French, Newtonian Mechanics, p. 217