it cannot impart acceleration to the system as a whole). This being so, there must exist some kind of supplementary interaction. In other words at least one more body must participate in the problem in addition to the horse and wagon. This body, in the given case is the earth. As a result, we have three interactions to deal with instead of one, namely:

(1) between the horse and the wagon (we shall denote this force by f_0;

(2) between the horse and the earth (force F), in which the horse pushes against the ground; and

(3) between the wagon and the earth (force f) which is the friction of the wagon against the ground.

All bodies are shown in Fig. 4.7 : the horse, the wagon and the earth and two forces are applied to each body. These two forces are the result of the interaction of the given body with the two others. The acceleration of the horse-wagon system is caused by the resultant of all the forces applied to it. There are *four* such forces and their resultant is $F - f$. This is what causes the acceleration of the system. Now you see that this acceleration is not associated with the interaction between the horse and the wagon. ♢

. So the earth's surface turns out to be, not simply the place on which certain events occur, but an active participant of these events. ■

4.18. Your pictorial comment is quite true. Incidentally, if you locate the horse and wagon on an ideal icy surface, thereby excluding all horizontal interaction between this system and the earth, there will be no motion, whatsoever. It should be stressed that no internal interaction can impart acceleration to a system as a whole. This can be done only by external action (you can't lift yourself by your hair, or bootstraps either). This is an important practical inference of Newton's third law of motion. ♢