required both on the ground and in the aircraft is complicated and expensive, but must be used if the system is going to be expected to work.[10]

The Theory of Traffic Separation.—Separation of en route traffic can be explained in what is admittedly an over-simplified illustration. Imagine a series of small birds each in a separate empty box car on a moving train. This is how ATC operates. When an airplane is issued an instrument flight clearance, it means that ATC has reserved for it a box of moving airspace along a track over the ground. The box is 5 miles wide (the width of a civil airway), 1,000 ft. high, and its length varies from 9–50 miles (the minimum length of the airspace reserved is usually the distance covered by the aircraft in three minutes—the allowance error margin). To be immune from collision neither the bird nor the aircraft need be in the precise center of its moving box; it may be at the top, bottom, or either end; so long as it does not stray into the adjacent box, the system creates a protective cocoon of airspace.

Visual Flight Rules (VFR) Operations.—Federal Air Regulations under which all aircraft operate, both general aviation and air carrier, provide that visual flight, sometimes called contact flight, may be carried on as long as the lateral visibility is three miles or more and the cloud ceiling at least 1,000 ft.[11] Under these conditions the see and be seen concept operates as it did 30 years ago. Aircraft separation and collision avoidance by law are the responsibility of the pilot, who is legally bound to look out the window. In the language of the courts, the pilot under such circumstances is bound to see what he would have seen if he had looked. This is true whenever the actual atmosphere is clear enough to permit visual flying.

It is frequently said that the "see and be seen" concept is no longer valid. This is nonsense. The conclusion of invalidity comes from the widely held misconception that *all* air carrier airplanes are jets, flying constantly at 500 mph, which, it is alleged, generates "instantaneous closure rates." Let us discuss this point.

The Federal Air Regulations require that airplanes flying on easterly and westerly headings above 3,000 ft. must fly with 1,000 ft. of vertical separation. Thus an aircraft proceeding east is 1,000 ft. above or below an aircraft going the opposite direction. Only if they are going in the same direction can they be at the same altitude. The closure rate between two aircraft going the same direction at the same altitude is the difference in air speed between the overtaking airplane and the one being overtaken. This is certainly not "instantaneous." Jets at *their* altitudes fly with 2,000 ft. of vertical separation. At low altitudes the regulations impose speed restrictions on jet aircraft as for example in terminal areas. An airplane flying at 240 mph transits a mile in 15 seconds, or three miles in 45 seconds. Under VFR conditions this is not anywhere near being an instantaneous closure situation. Try holding your breath that long. As a better example: in 15 seconds an automobile traveling 60 mph travels a quarter of a mile, 1,320 ft., yet most of us operate in this environment without giving a thought to such a thing as instantaneous closure rates or considering that there might be a problem in swerving to avoid colliding with a car a quarter of a mile away. The only requirement is that the pilot be alert and look out the window.

Instrument Flight Rule (IFR) Operations.—Whenever the ceiling is less than 1,000 ft. or lateral visibility less than three miles, instrument flight rules (IFR) as prescribed by the Federal Air Regulations go into effect. Under these conditions only instrument rated pilots (those who are (1) licensed for this special type of flying; (2) using aircraft equipped with properly calibrated instruments; and (3) operating under Air Traffic Control-issued Instrument Clearances are legally permitted to fly. Everyone else is grounded *by law*. The restrictions on instrument flying and the level of proficiency required to engage in it are spelled out in the regulations in great detail.[12] The result is that under IFR conditions, the vast majority of general aviation aircraft which are not flown for business and therefore whose fair-weather pilots do not need or use instrument ratings, do not use the federal airways system, nor the air traffic control system.

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[10] Typical general aviation nav/comm equipment as widely used:

Type	*Price range*
Automatic direction finder	$1,088–$4,376
Distance measuring equipment	2,800– 7,000
VOR nav/comm transceivers	795– 3,400
VOR localizer indicators	400– 545
3-light marker beacons receiver	249– 320
Radar transponder	2,200– 5,000

[11] *Federal Aviation Regulations,* Part 91.

[12] *Ibid.,* Part 91, Sec. 91.105(b), Parts 95 and 97.