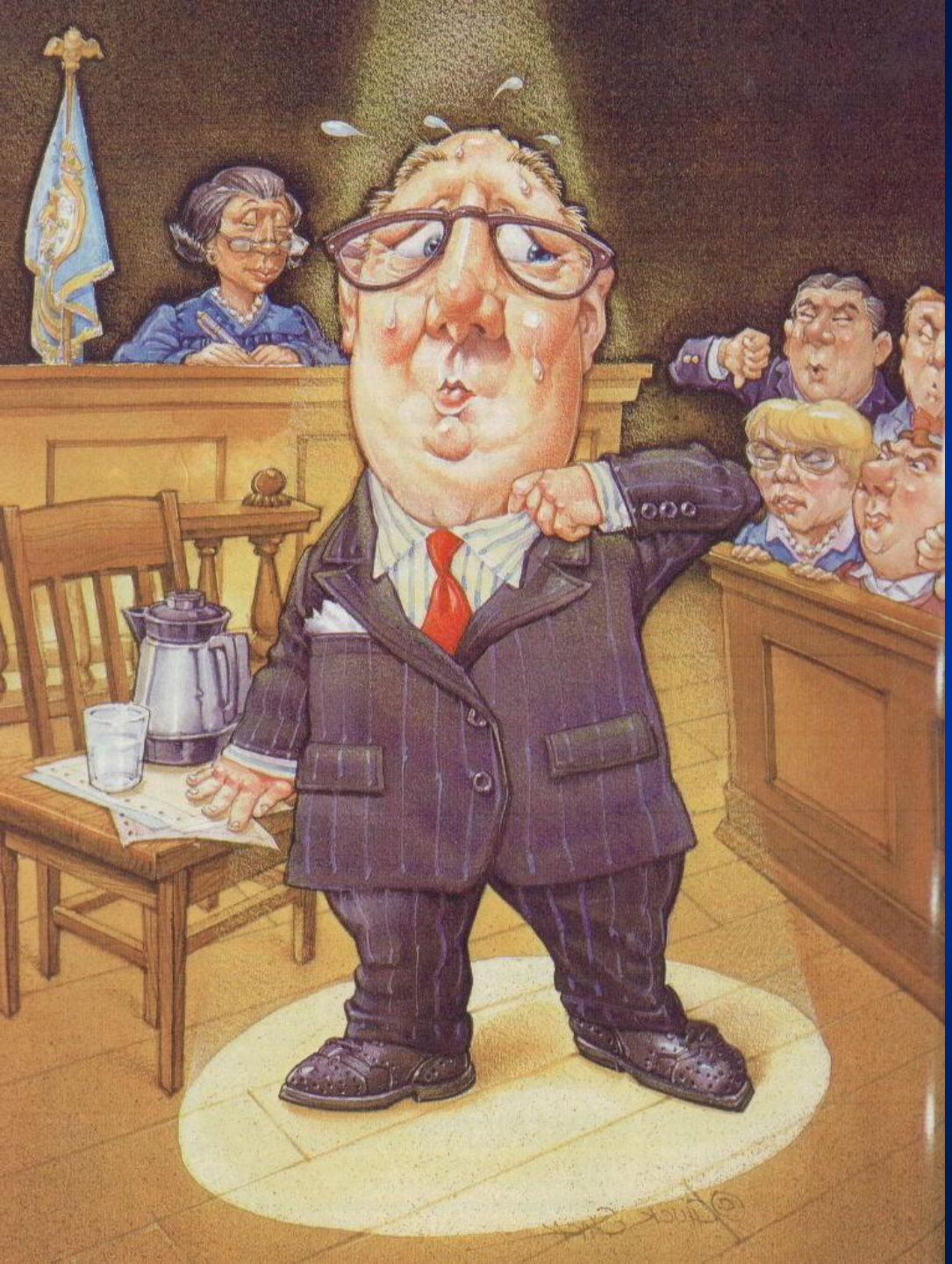
The Reconstruction Vocabulary



“If I had been good at math...”

You don’t have to be good at math, but…. you must understand the expert’s vocabulary.

Are speed and velocity the same?

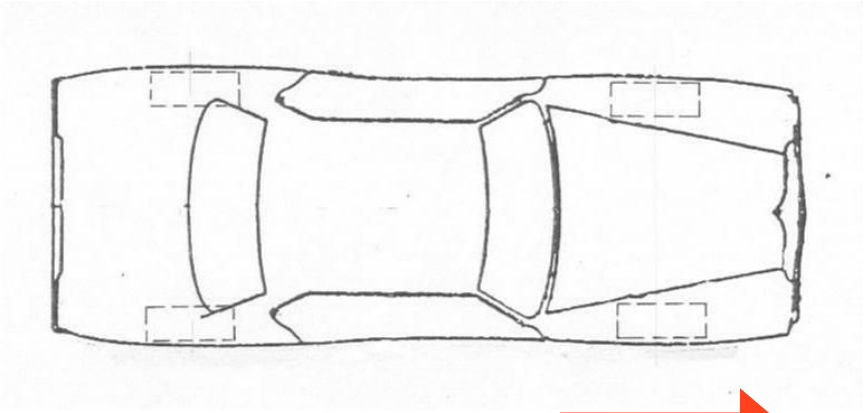
speed is how fast something is moving

ft/sec

mph

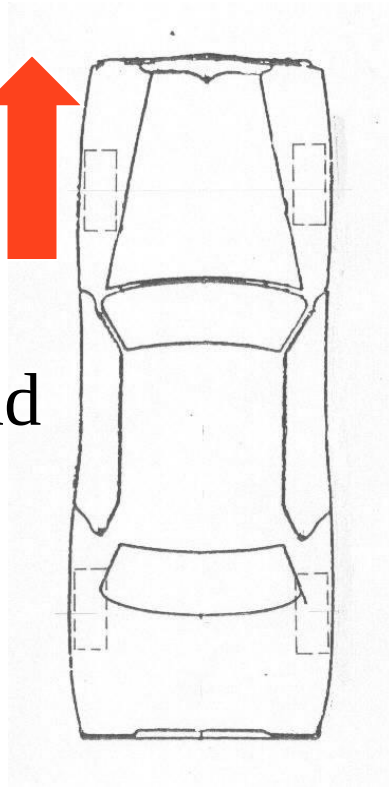
velocity is the speed *and* the direction

velocity is called a *vector*



30 mph
Eastbound

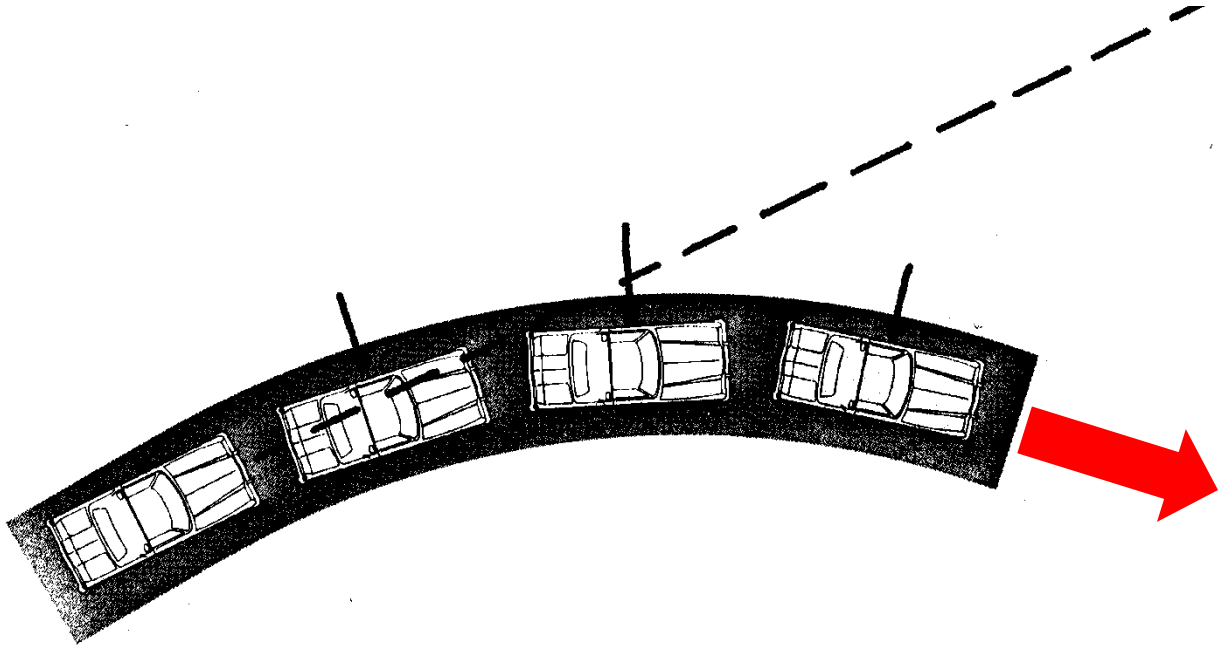
30 mph
Northbound



same speeds,
different velocities

Here’s what happened when a prosecutor didn’t understand the expert’s vocabulary!

DEFENSE EXPERT TESTIMONY:



"The vehicle maintained
a constant speed of 35 mph
as it accelerated through the turn."

What does acceleration mean ?

Acceleration occurs when there is a change in velocity, $\Delta\vec{\mathbf{V}}$.

What does acceleration mean ?

Acceleration occurs when there is a change in either speed or direction

What does acceleration mean ?

Speeding up

Slowing down

(braking)

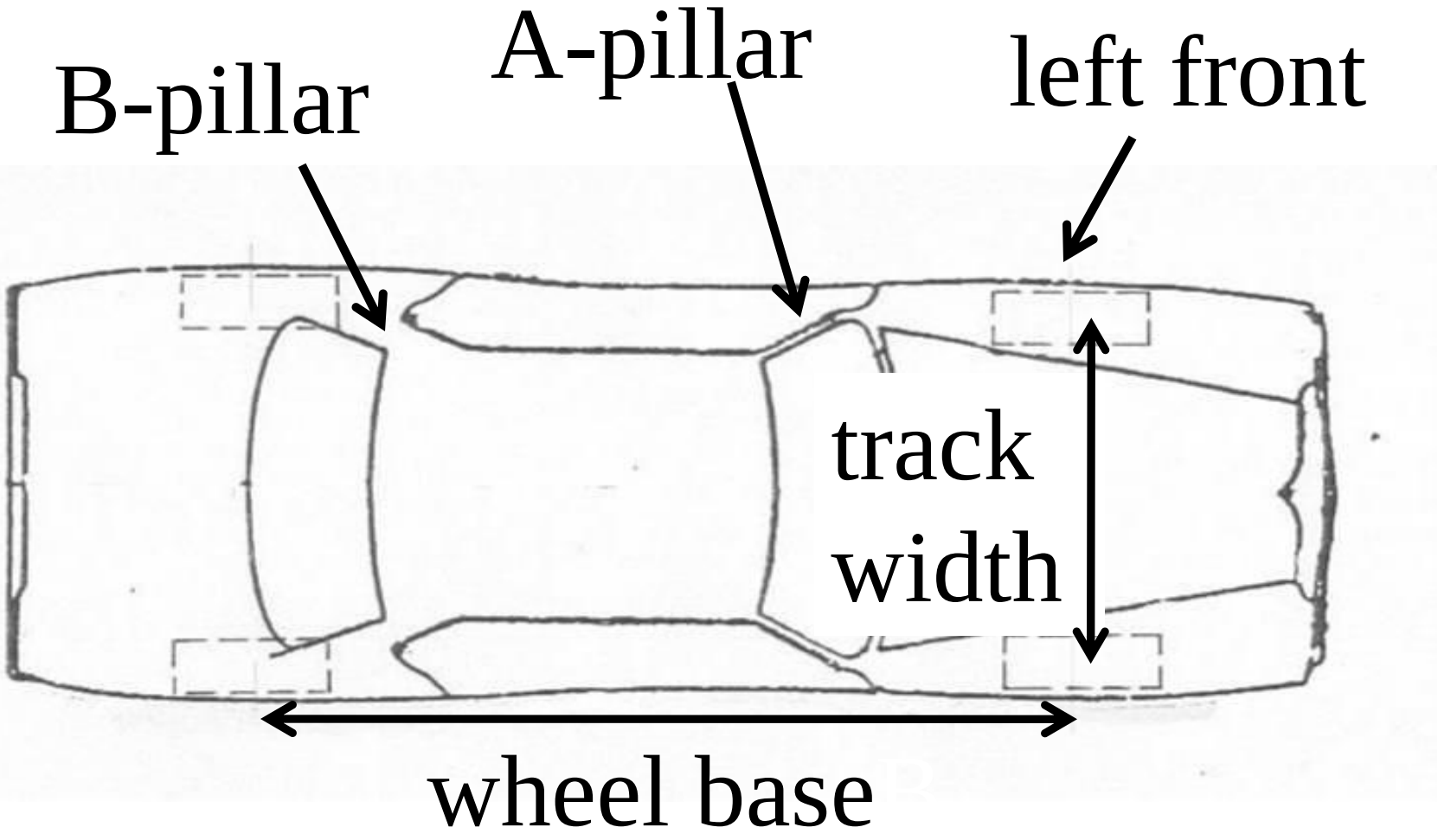
Changing direction

(steering)

Satchel Paige

"It's not what you don't know that will get you in trouble – it's what you do know that ain't so."

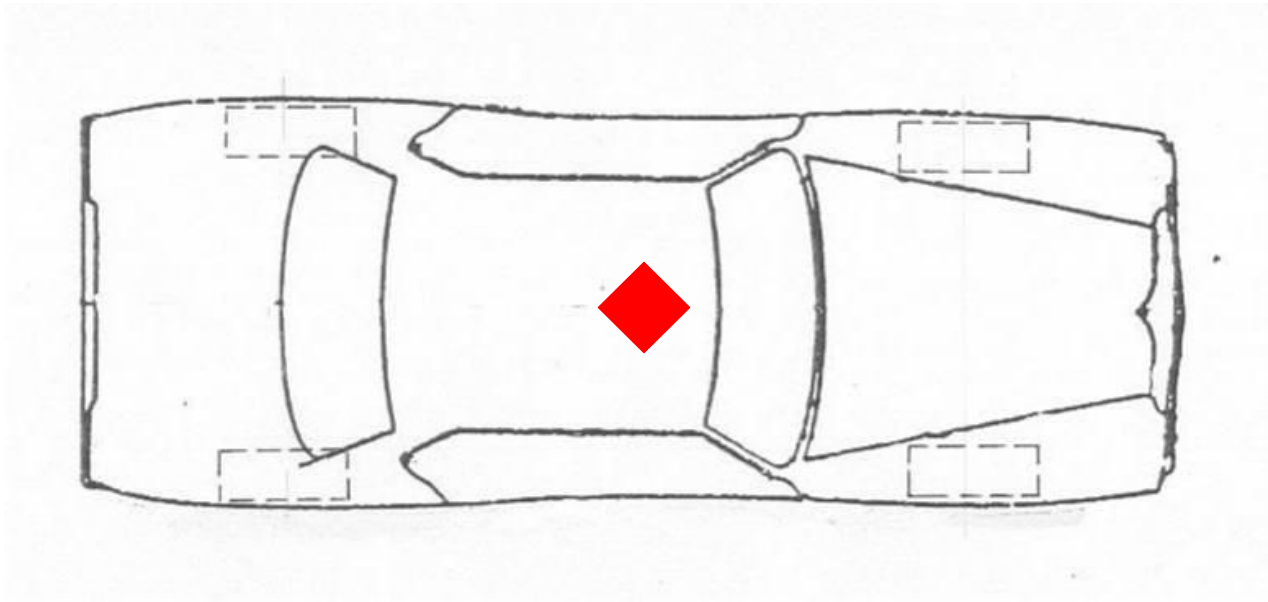
VOCABULARY

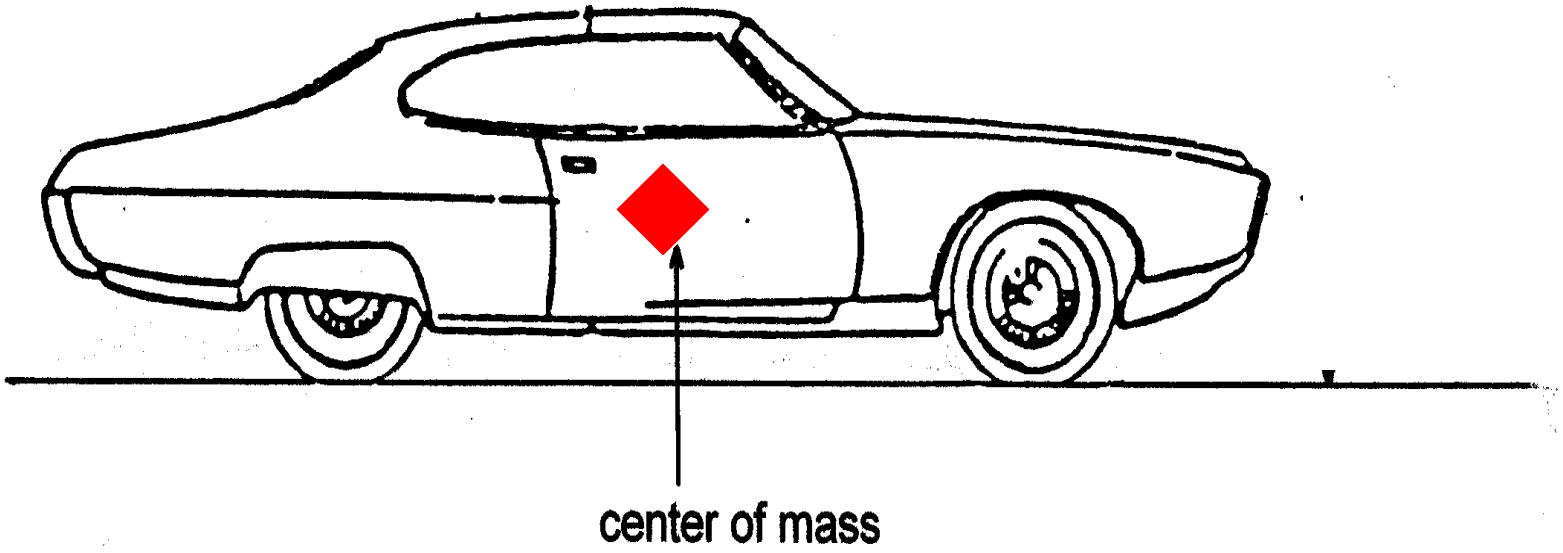

B-pillar
A-pillar
left front
track
width
wheel base

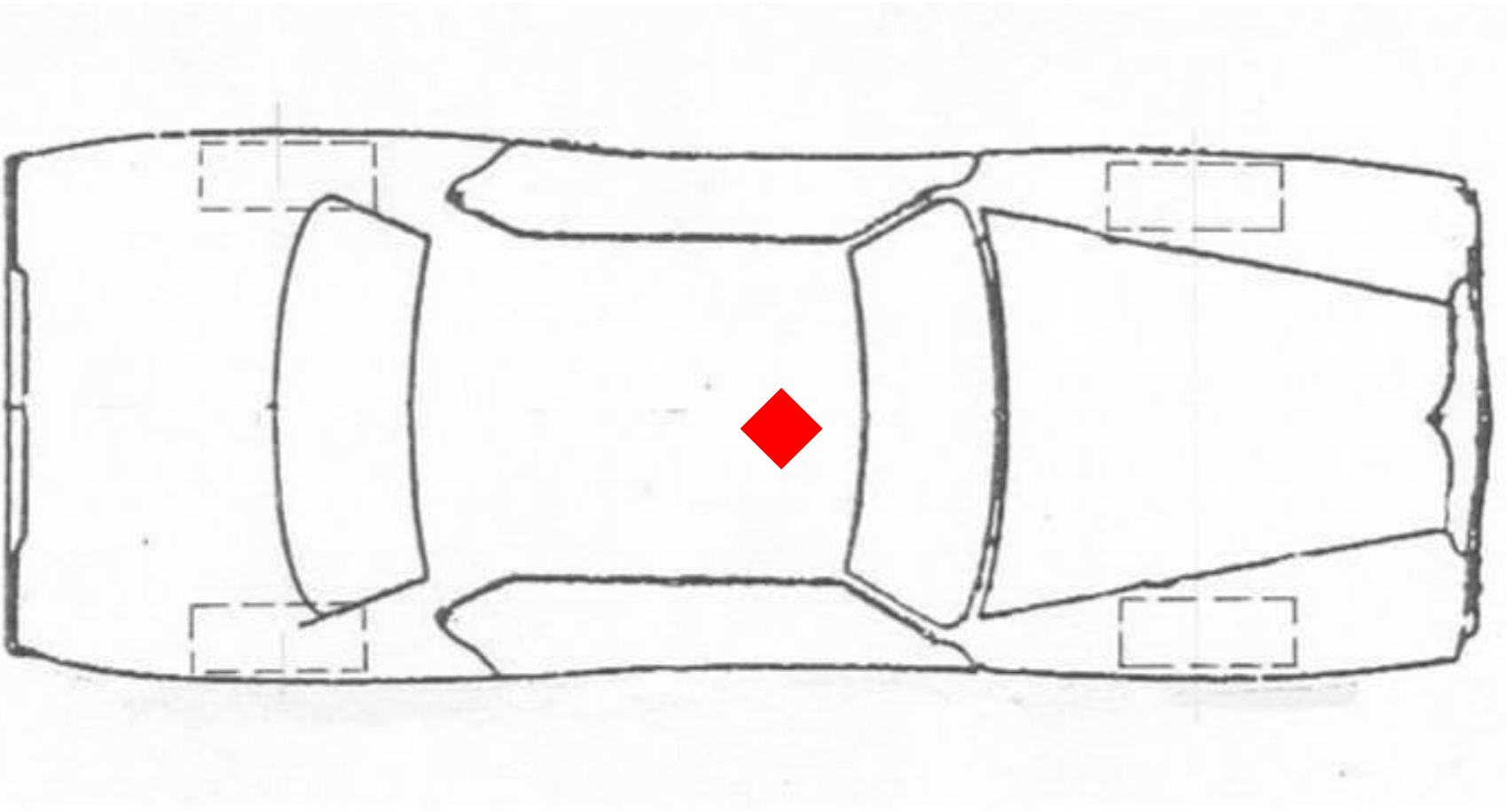
center of gravity

THE POINT WHERE THE WEIGHT SEEMS TO BE CENTERED

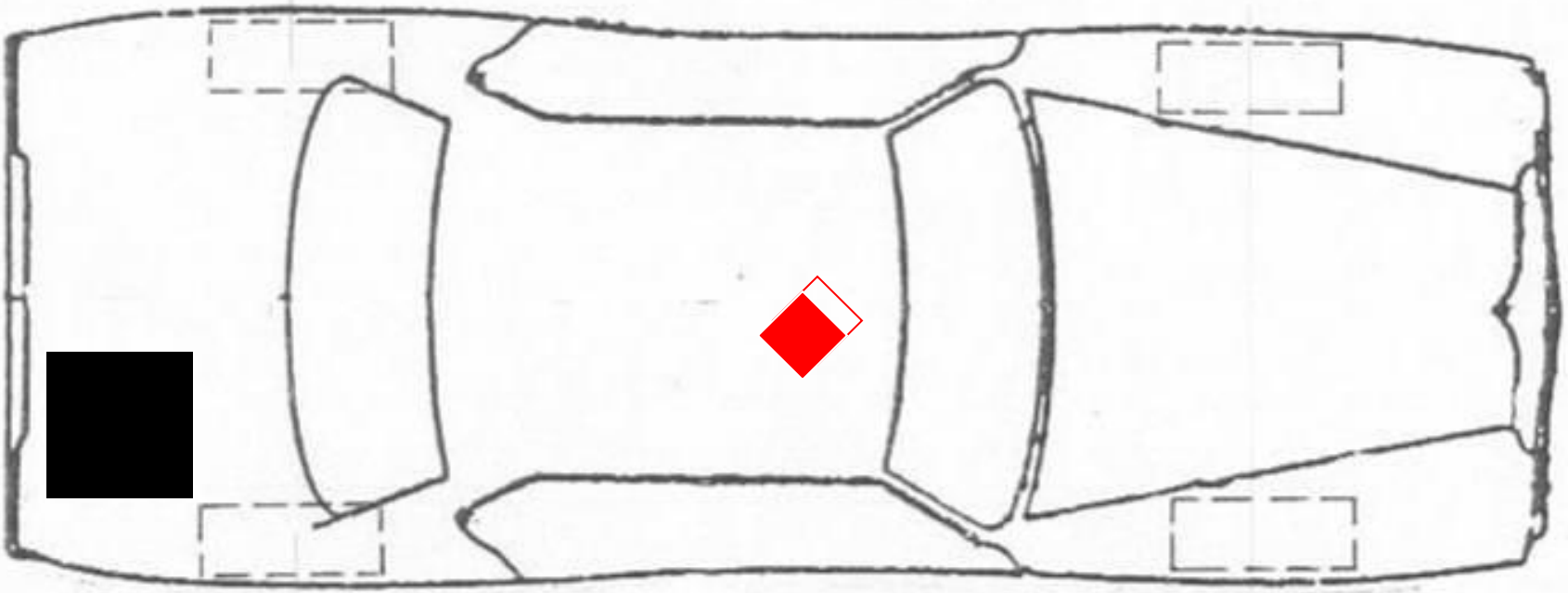
THE “BALANCE POINT”

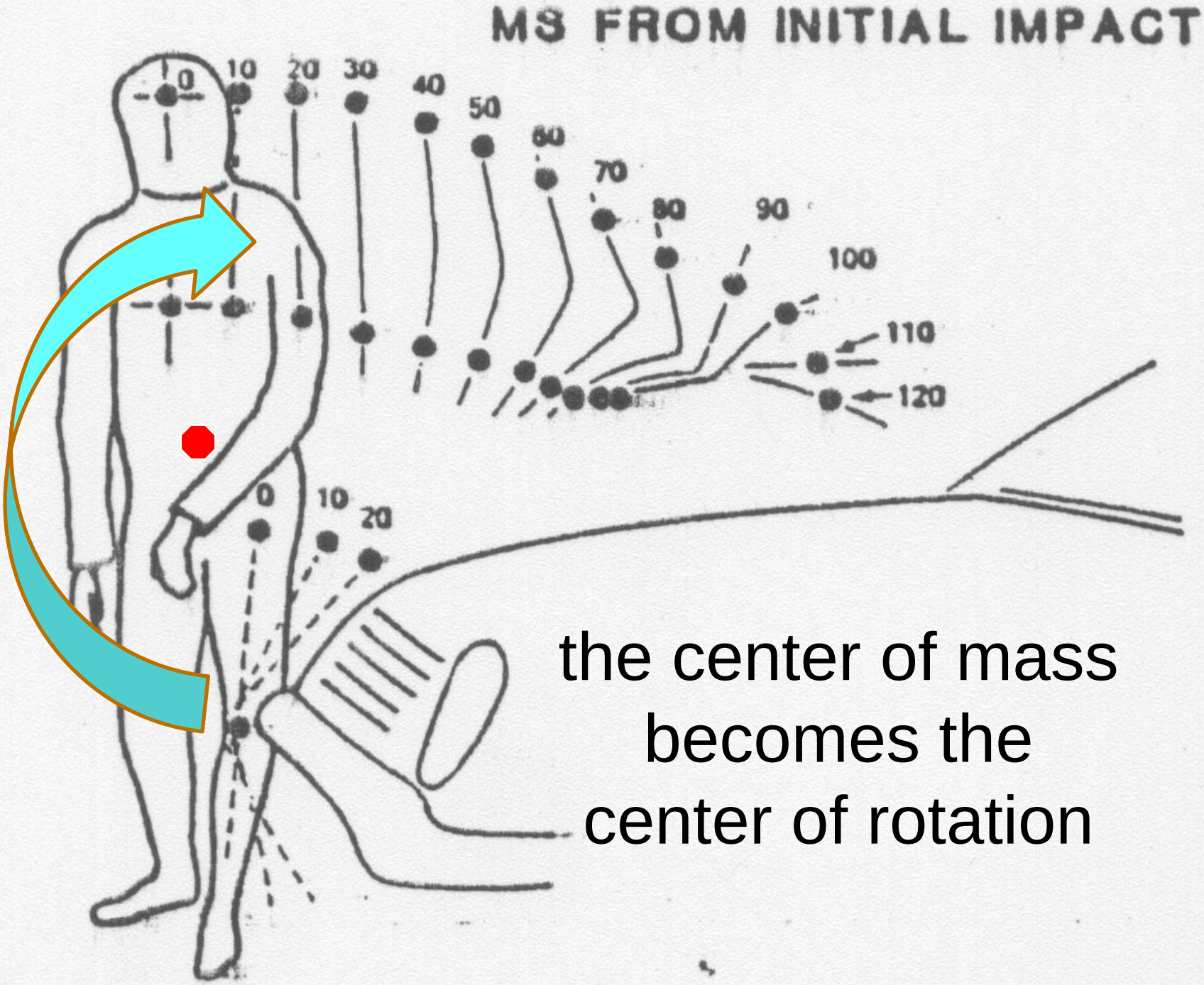



center of mass



The location of the C.M. can change.



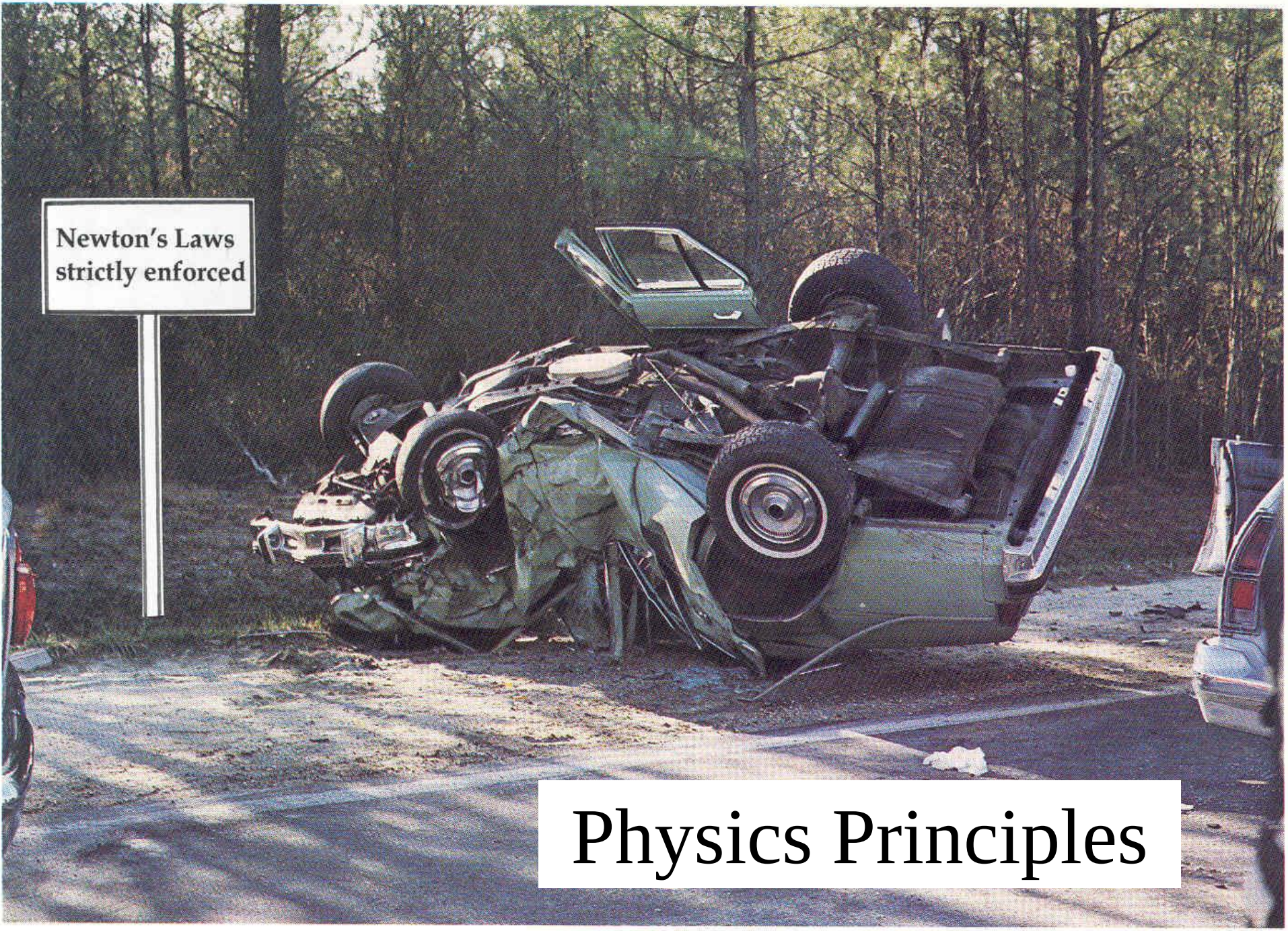


the center of mass becomes the center of rotation

FACT:

The location of the center of mass is seldom used in the calculations !

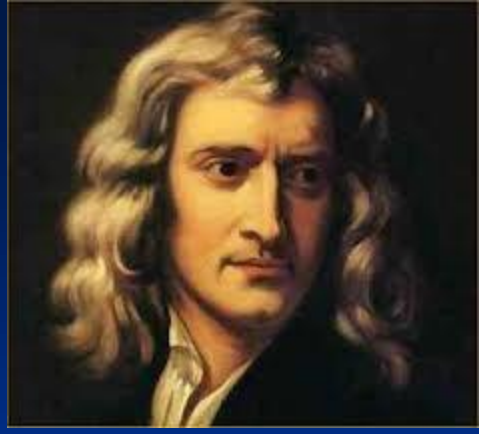
But ... beware of the defense!



Physics Principles

NEWTON'S FIRST LAW:

Part 1



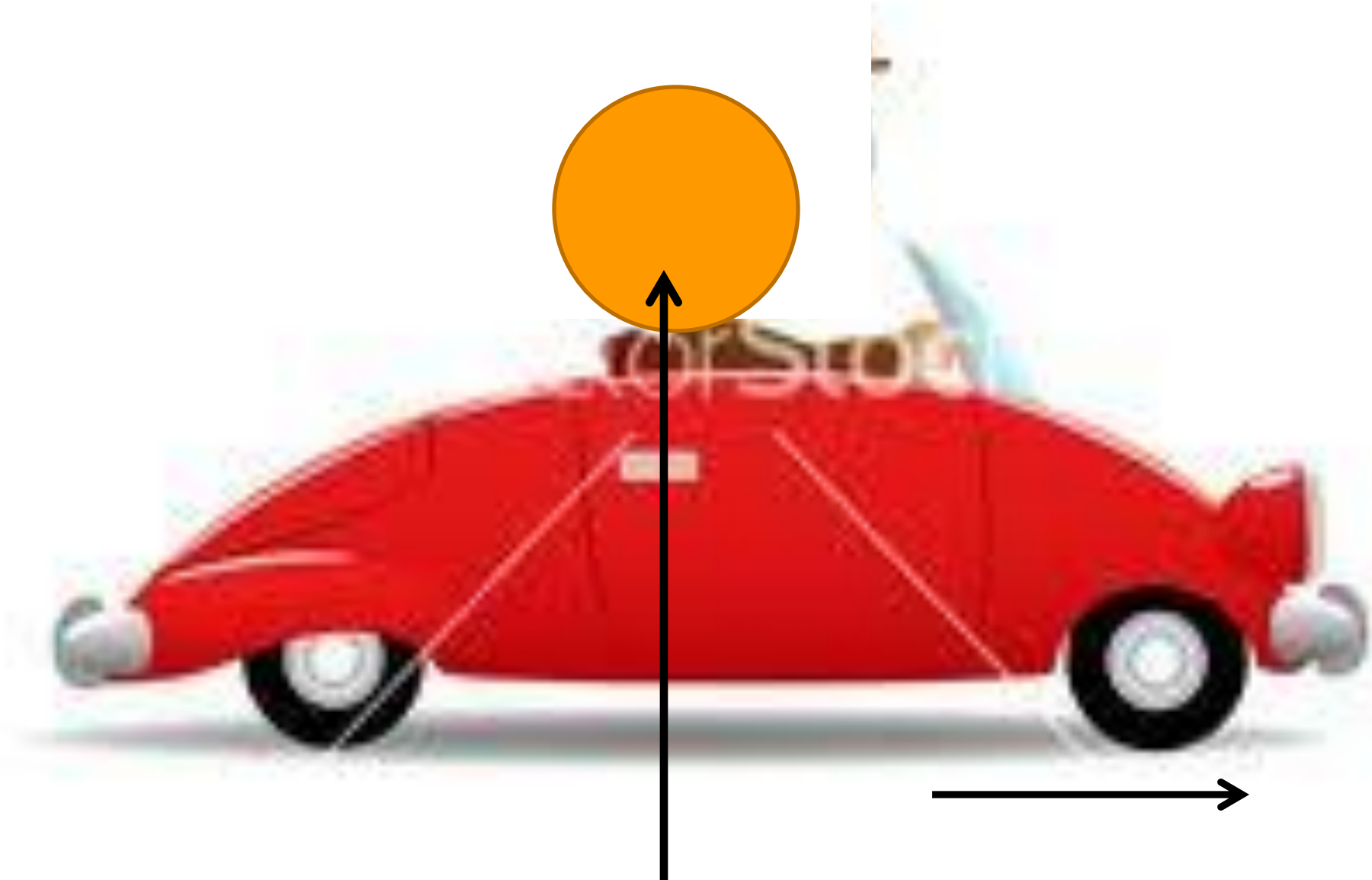
An object at rest remains at rest, unless a force acts on the object to change its motion.

NEWTON'S FIRST LAW:

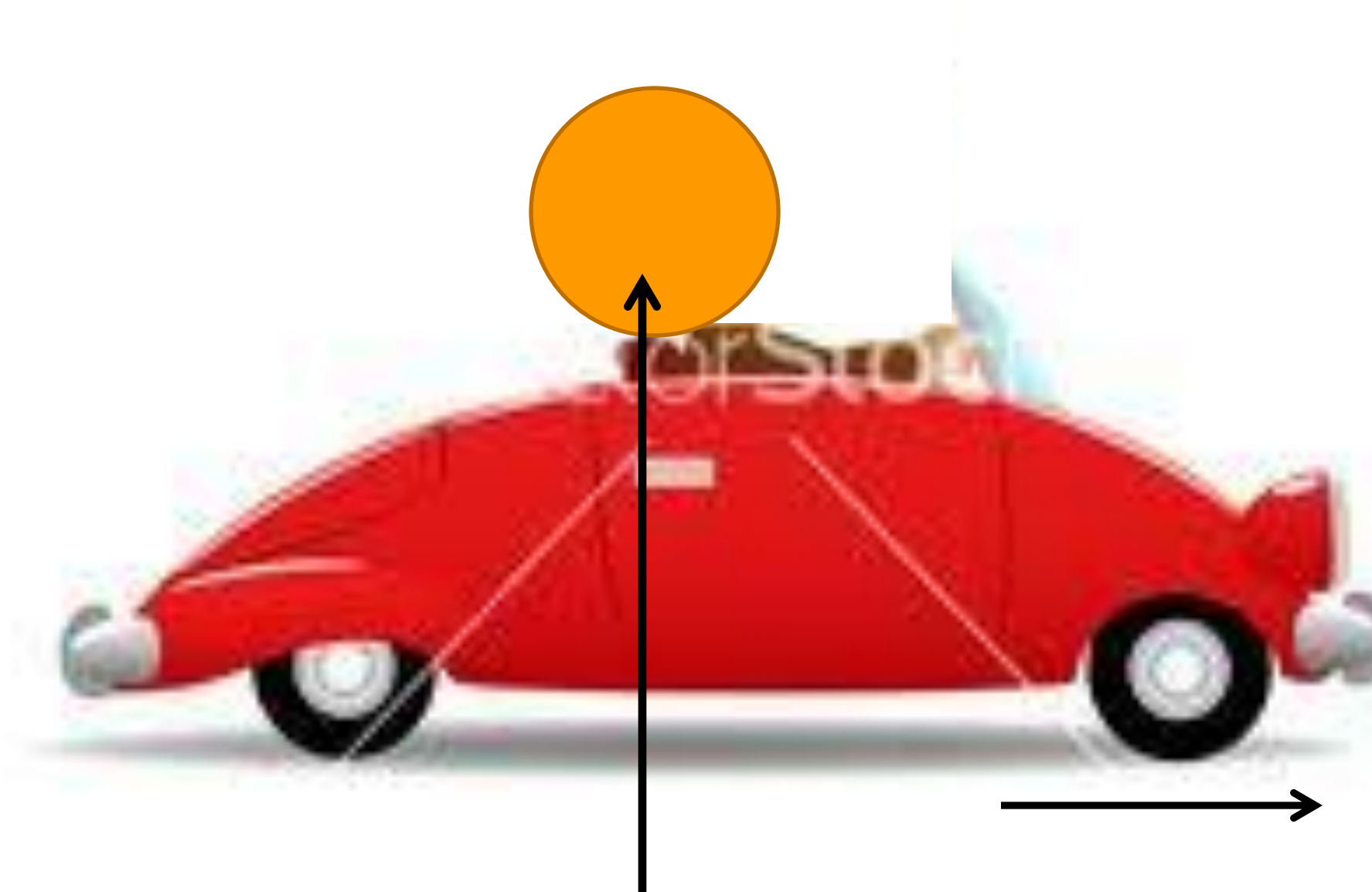
AN OBJECT AT REST (the head)
REMAINS AT REST

STOPPED VEHICLE, STRUCK FROM REAR

STOPPED VEHICLE, STRUCK FROM REAR

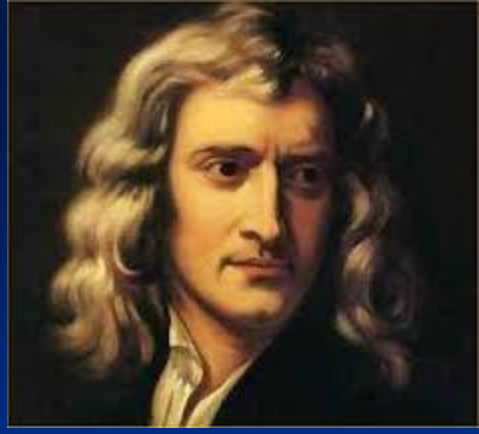


VEHICLE moves forward, HEAD stays in place



NEWTON'S FIRST LAW:

Part 2



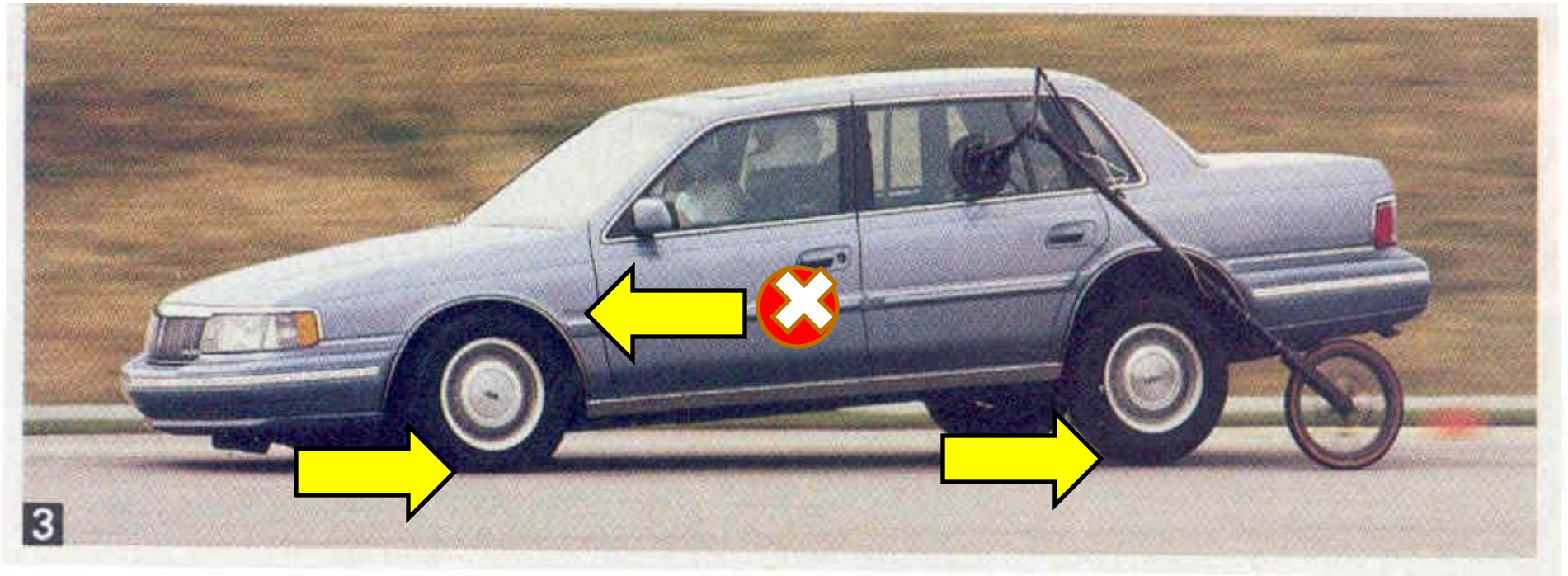
An object in motion maintains its motion, unless a force acts on the object to change it.

NEWTON'S FIRST LAW:

AN OBJECT IN MOTION MAINTAINS ITS MOTION …

Fact:

In a pedestrian crash the height of the bumper ***will not always match*** the location of the impact injury on the pedestrian.


3

“pitching” or “bumper dive”

During hard braking…

weight shifts onto the front tires

Notice the shape of the tires.

Let’s do an experiment to show how friction is related to weight.

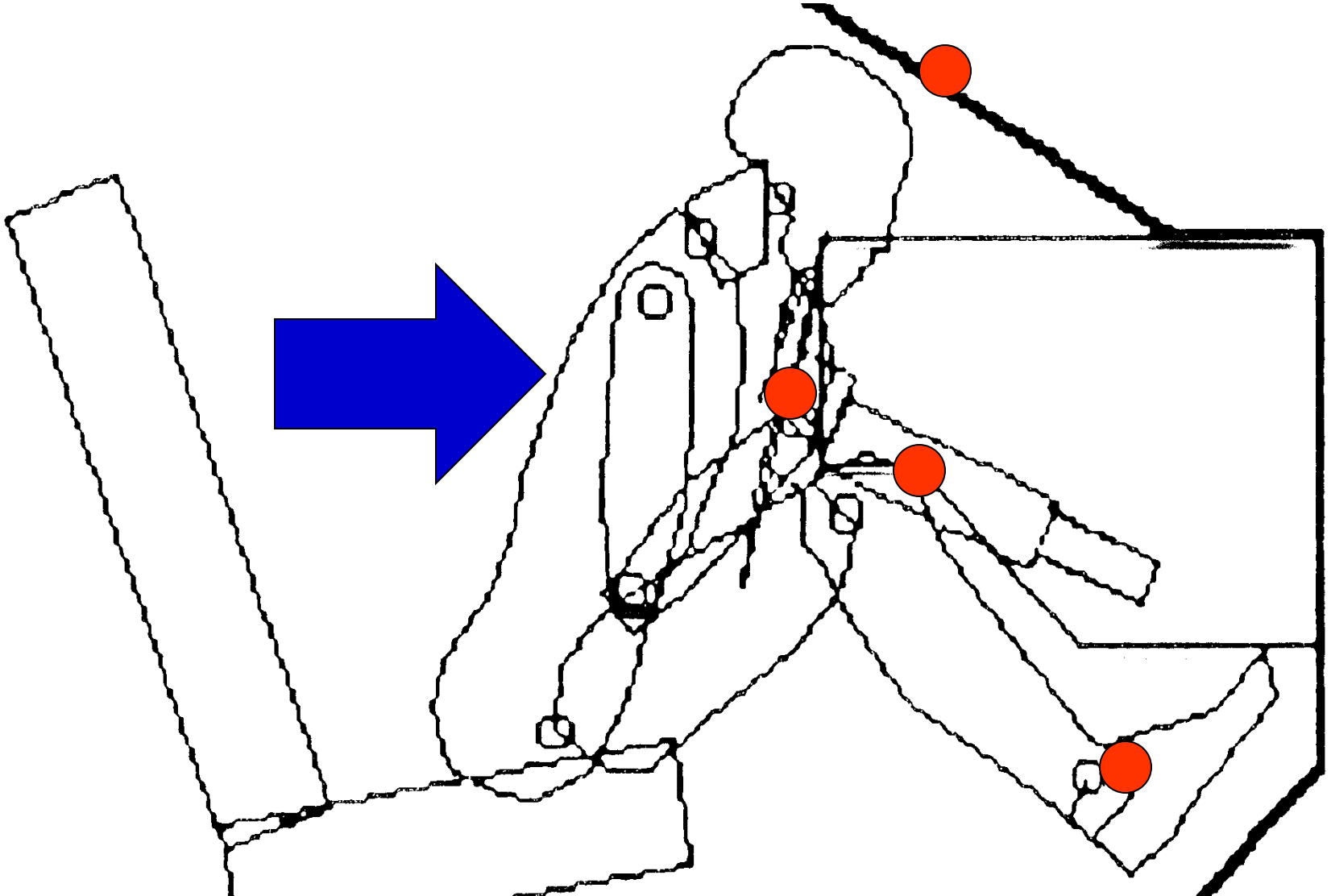
Friction is proportional to weight

Friction force = f x W

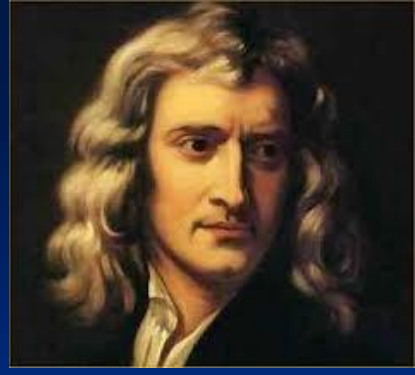
Why do the tire marks look like they do?

CSI

FIRST LAW MOTION MAY PRODUCE EVIDENCE OF OPERATION




CUFF



NEWTON'S SECOND LAW:

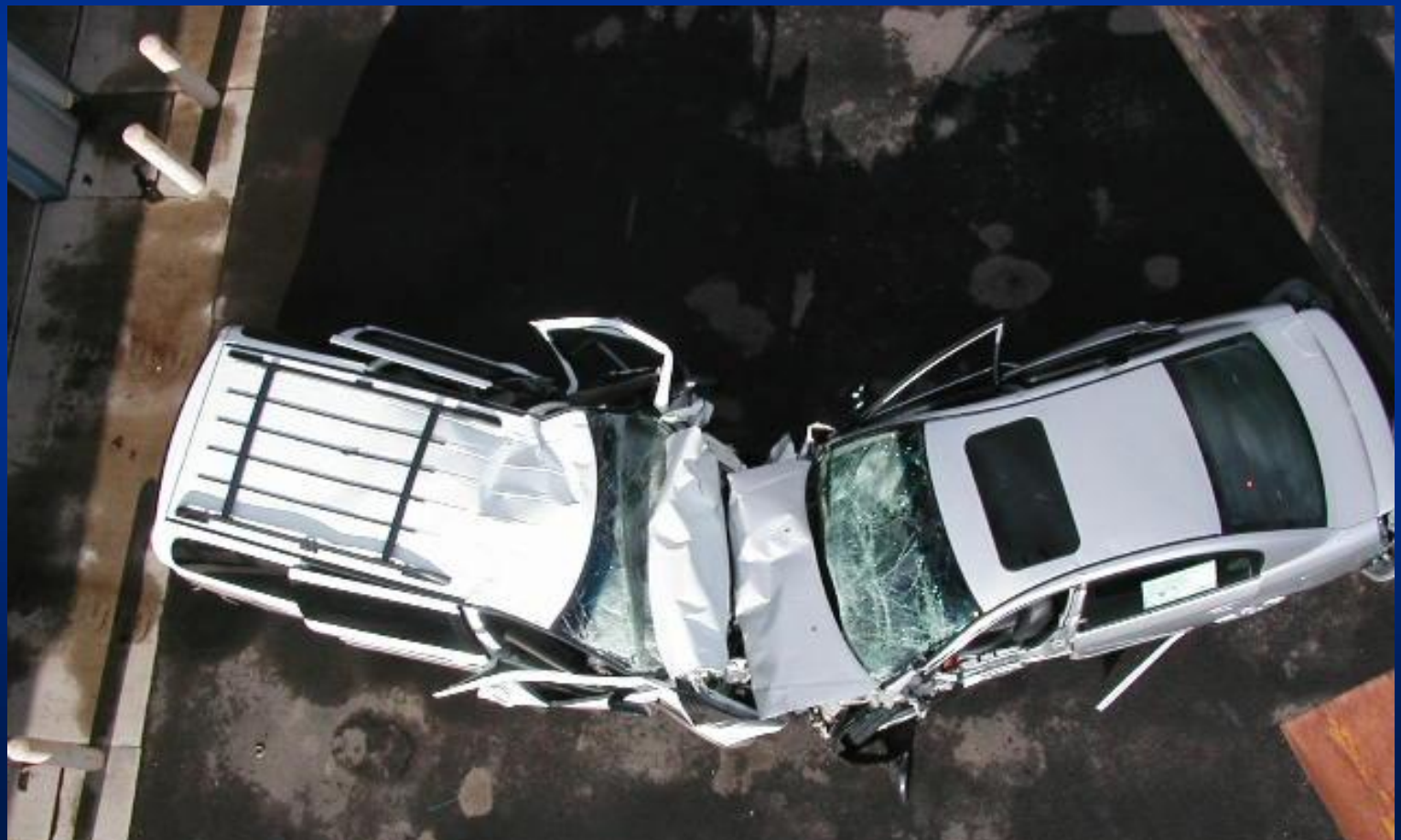
FORCES CAUSE MASSES TO ACCELERATE

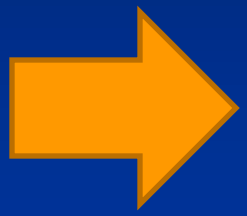
$$\vec{F} = m\,\vec{a}$$

Acceleration is the rate at which the velocity is changing:

$$\vec{a} = \Delta\vec{V} / \Delta t$$

“Crumple Zones” increase Δt and reduce acceleration, ΔV/Δt



low $\Delta V / \Delta t$  air bag may not deploy

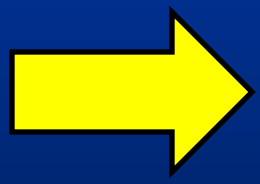
Air bag in rear car did not deploy

The weight of a vehicle
is not a factor in the braking
distance it takes to stop a vehicle

Remember the friction experiment…

more weight, more friction

Let’s really add some weight and compare how a vehicle stops.

52,000 lbs  92,000 lbs

BOTH VEHICLES STOPPED IN THE ***SAME DISTANCE***

the baking distance equation

$$X_b = S^2 / 30\ f$$

Weight is *not* a factor in the braking distance equation

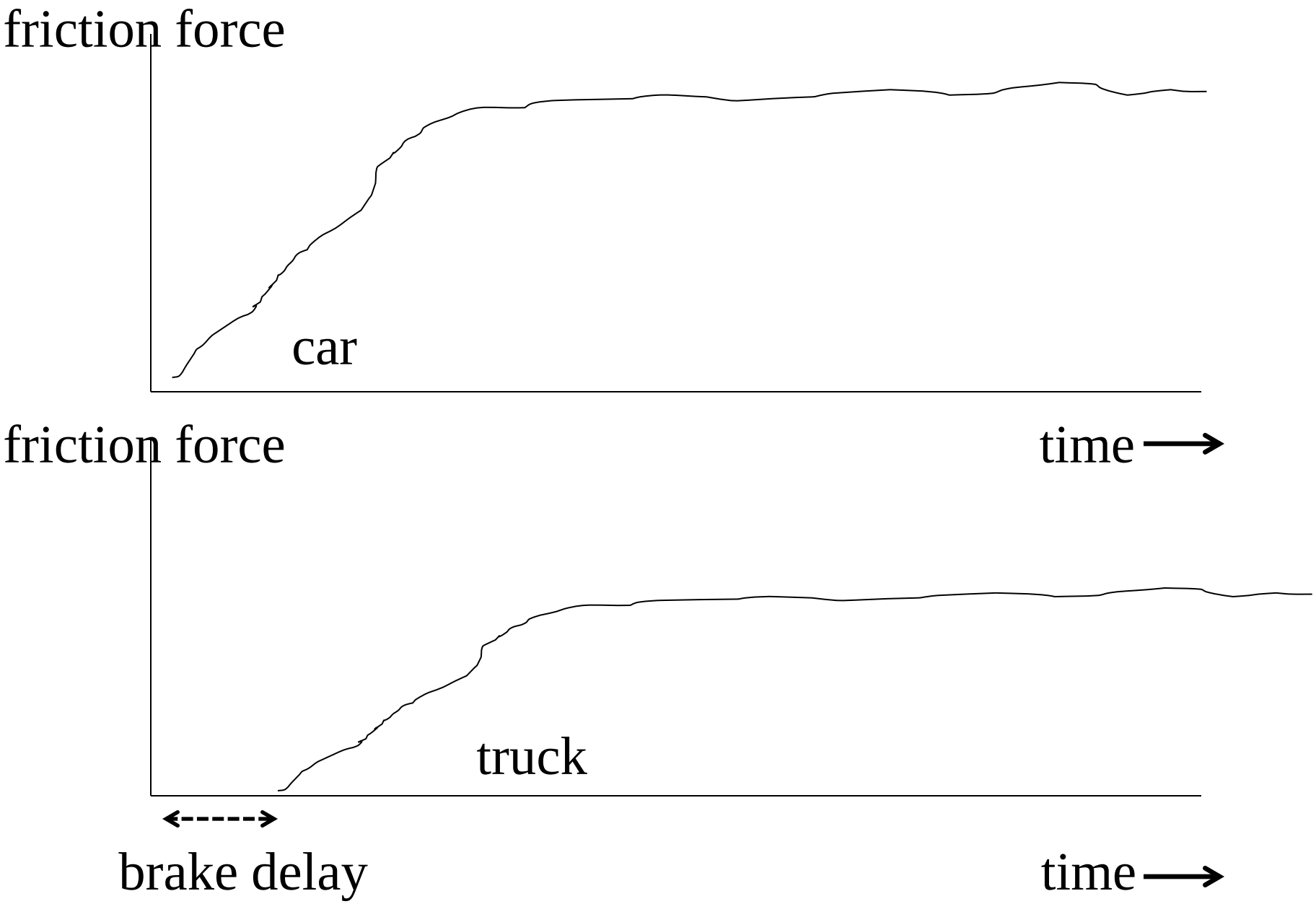
$$X_b = S^2 / 30\ f$$

HOW ABOUT A

TRACTOR TRAILER AND A CAR?

Why does the truck have a longer braking distance than the car?

truck has pneumatic “brake lag”
(a delay in the braking)


friction force
car
friction force
time
truck
brake delay
time

truck has pneumatic “brake lag”

tires are made of
different rubber compounds,

truck	car
(hard)	(soft)
(less friction)	(more friction)

NEWTON'S THIRD LAW:

WHEN OBJECTS COME INTO CONTACT, EQUAL AND OPPOSITE FORCES ACT ON BOTH OBJECTS

(ACTION-REACTION FORCES)

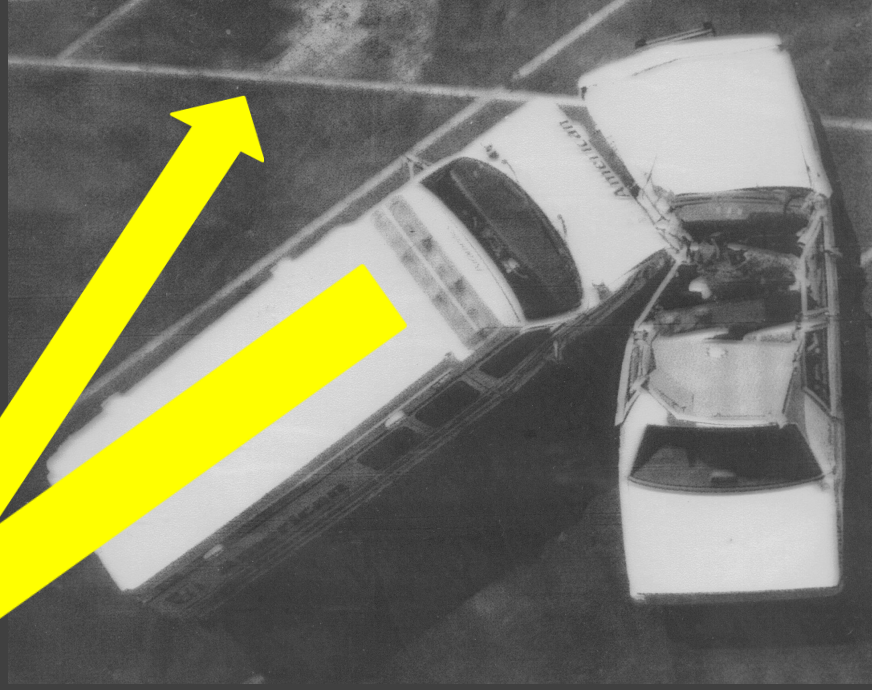
the “ACTION” force

the “REACTION” force

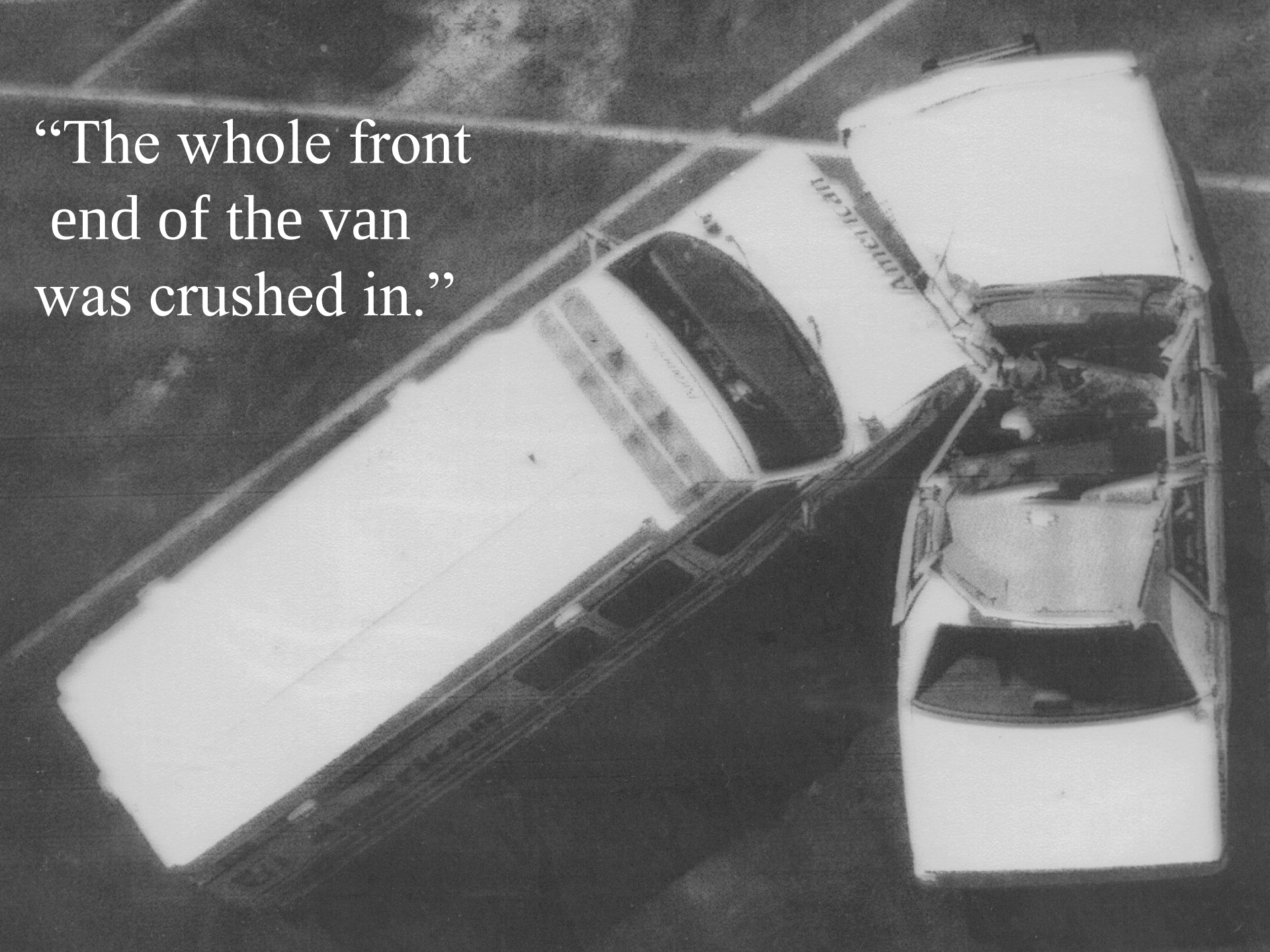
EQUAL FORCES, but UNEQUAL DAMAGE ?

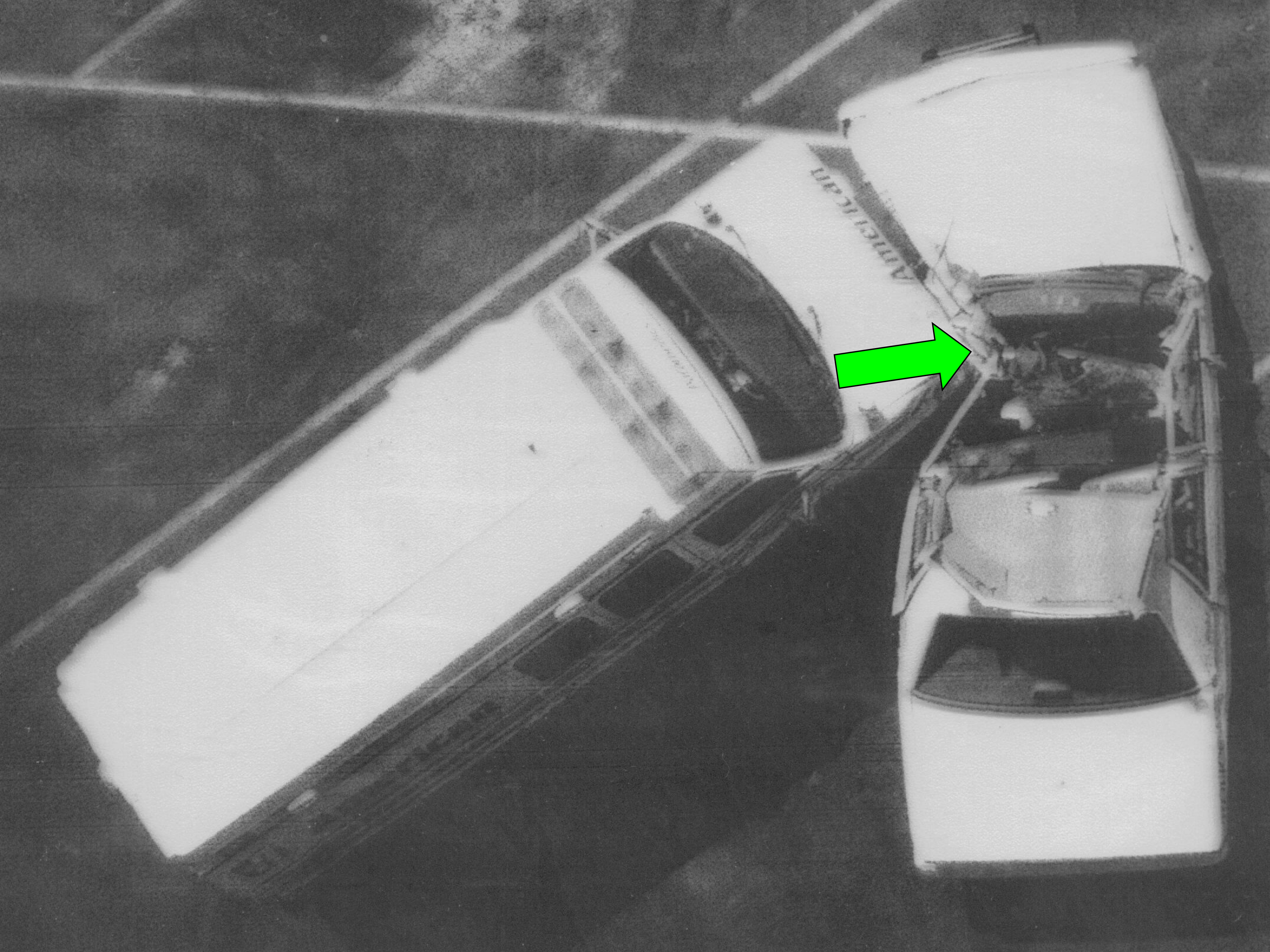

American

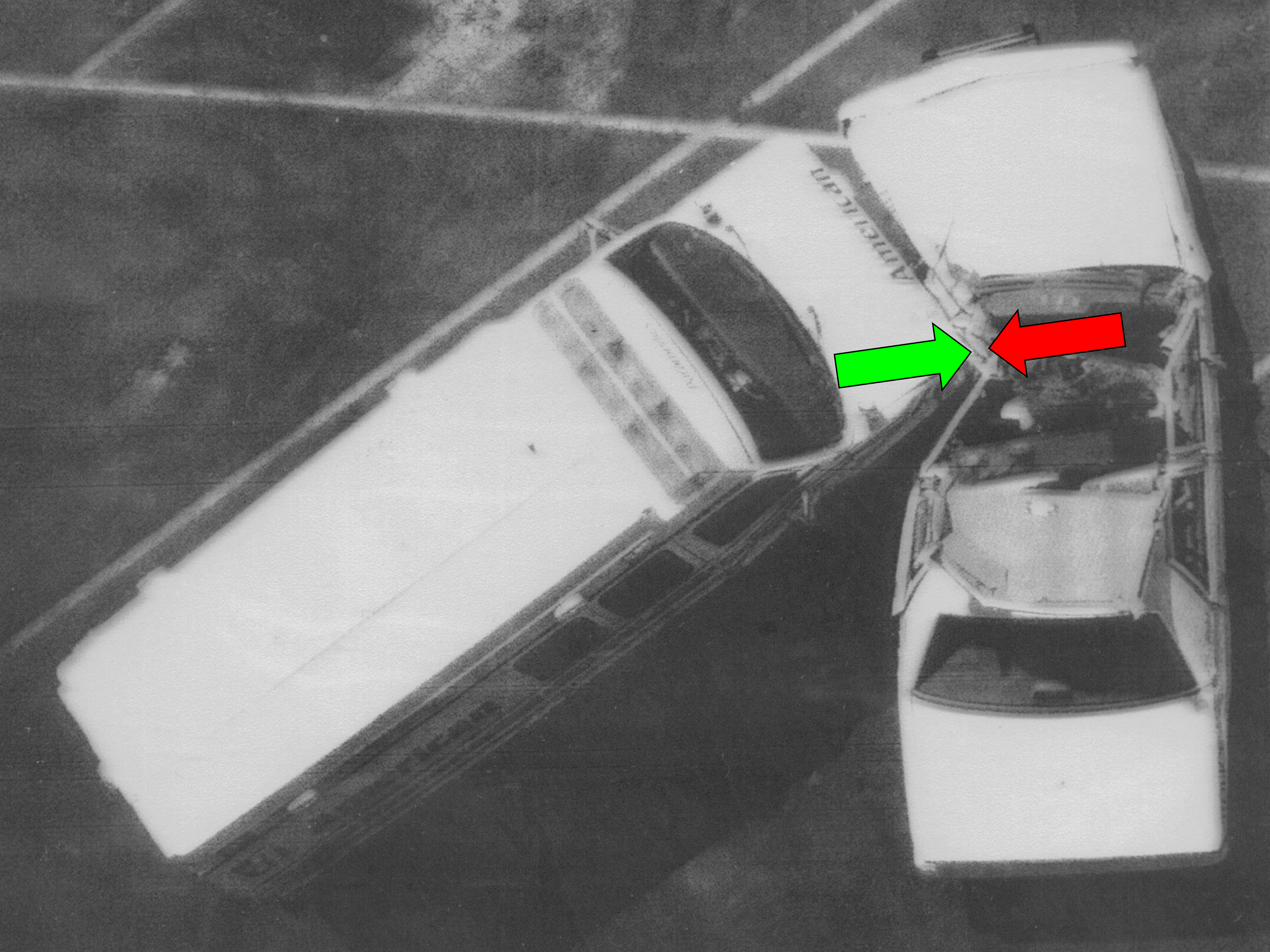
“The whole front end of the van was crushed in.”



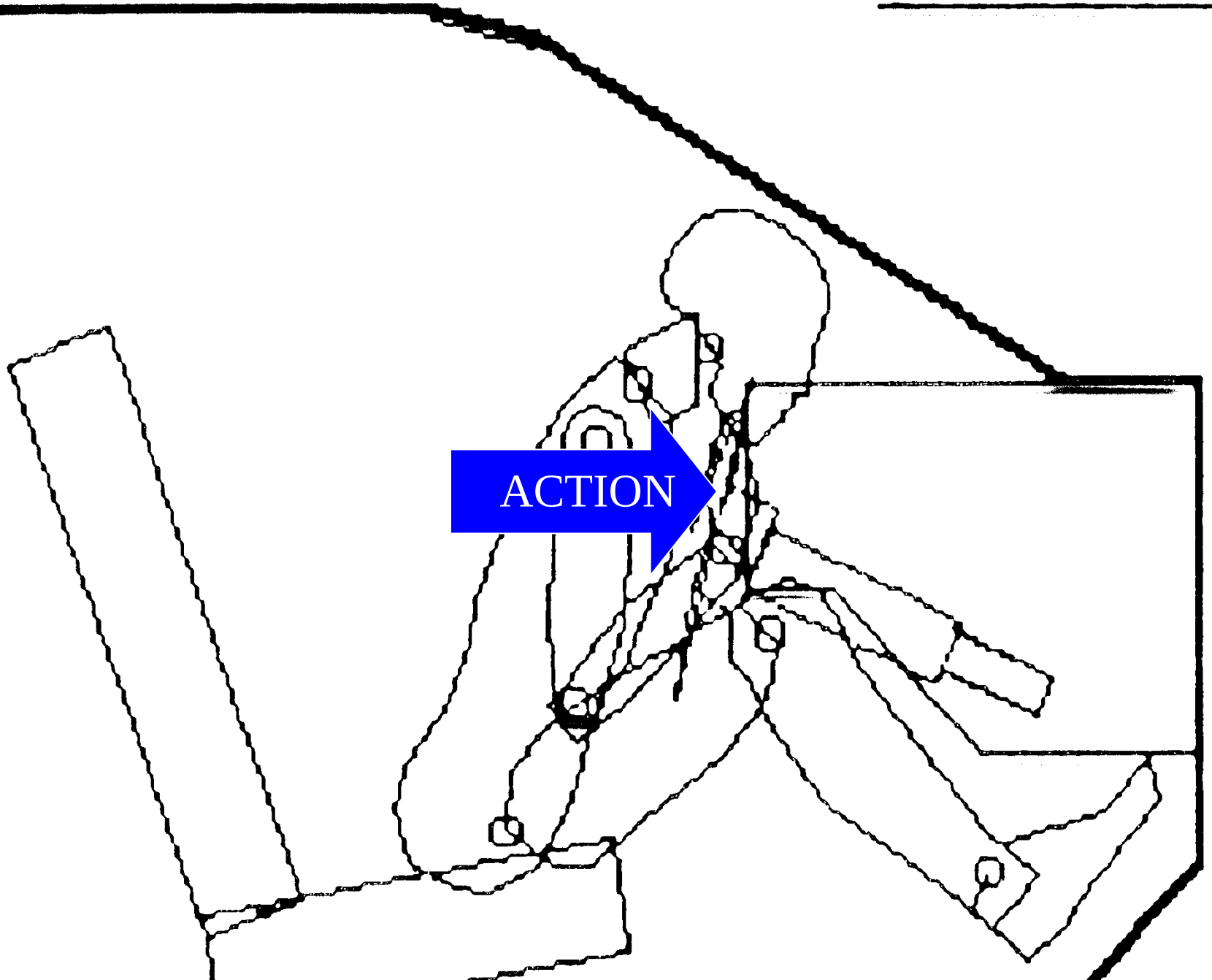
eye witness


"The whole front
end of the van
was crushed in."

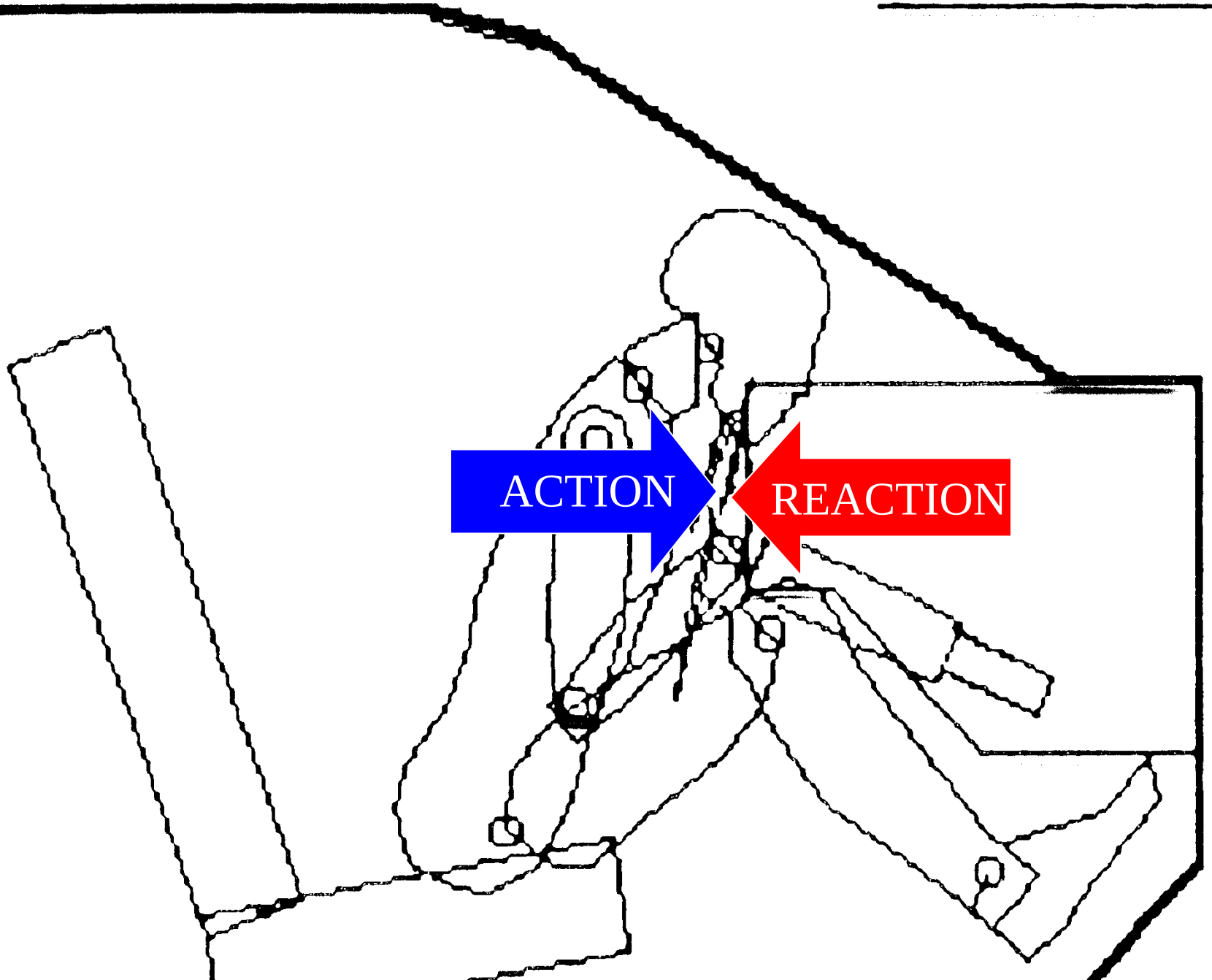

American

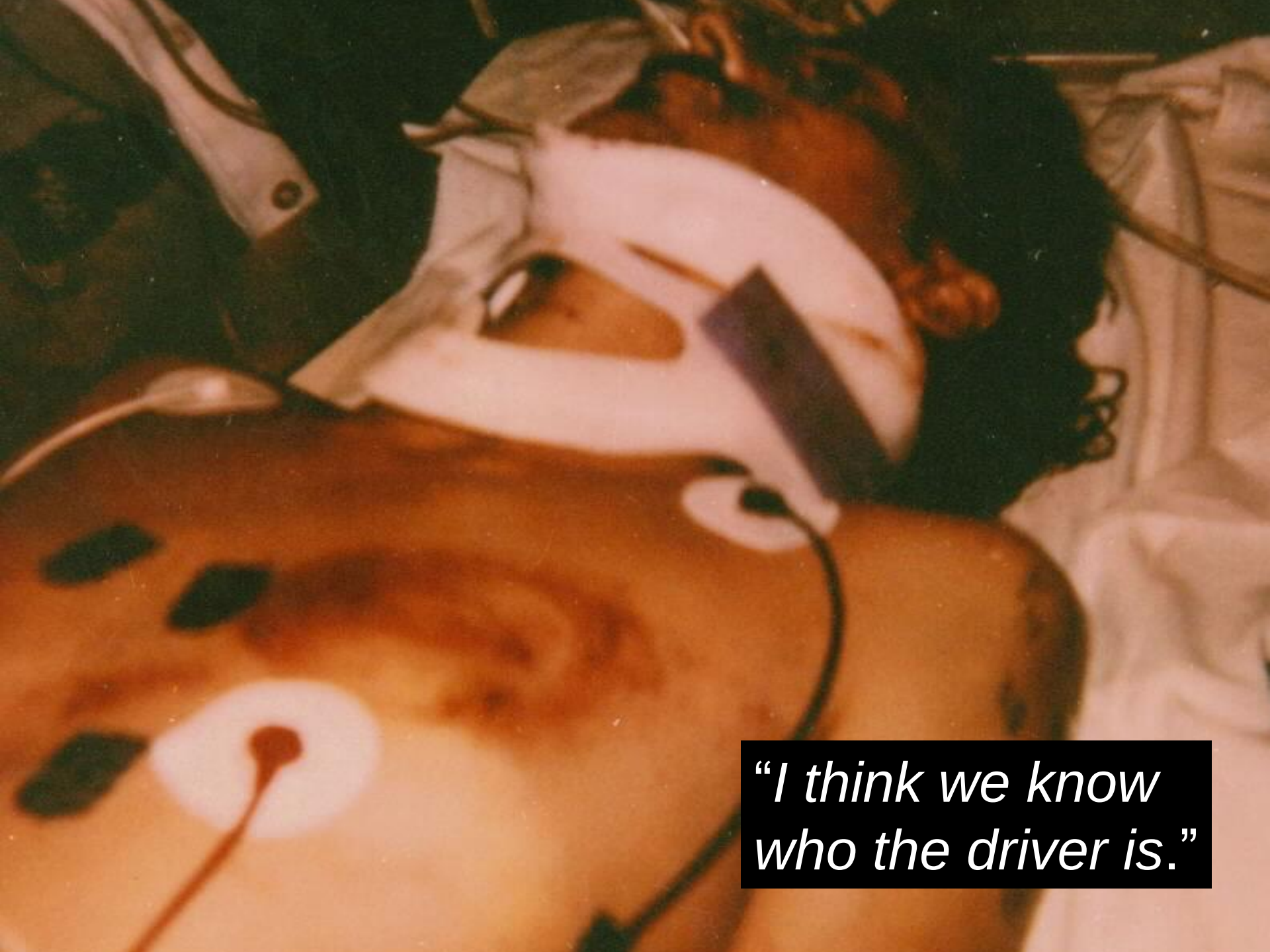

American

UNRESTRAINE



UNRESTRAINE




“I think we know who the driver is.”

Newton had 3 Laws of Motion

Kwasnoski's FOURTH LAW

FOR EVERY EXPERT OPINION

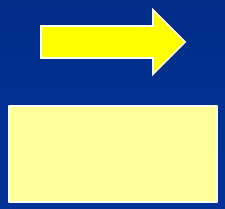
THERE IS AN

OPPOSITE EXPERT OPINION.

KINETIC ENERGY $= \frac{1}{2} m v^2$

KINETIC ENERGY = .03376 W S^2

$KE = .03376\ W\ S^2$



A MOVING VEHICLE HAS KINETIC ENERGY

$KE = .03376\ W\ S^2$

DURING A CRASH THE KINETIC ENERGY IS LOST

$KE = .03376WS^2$

THE VEHICLE AT REST HAS NO KINETIC ENERGY

CONSERVATION OF ENERGY

THE KINETIC ENERGY OF A VEHICLE IS CHANGED TO OTHER FORMS AS THE VEHICLE REACHES ITS STOPPED POSITION (FRP).

CONSERVATION OF ENERGY

THE CRASH INVESTIGATOR LOOKS FOR THOSE ENERGIES TO RECONSTRUCT THE PRE-CRASH ENERGY (SPEED)

Now let’s apply the science.