Letters to the Editor

Use of Perchloric Acid as an Oxidizing Agent

Commercial perchloric acid of 60 to 70 per cent concentration has been recommended by several investigators for the destruction of organic matter in various analytical procedures. We have been using it for the estimation of small amounts of iodine and phosphorus in plant material, both by itself and with sulfuric and nitric acids. Recently we have had a violent explosion for no apparent reason after the oxidation with dried potatoes had been completed and when the mixture was cooling spontaneously. This occurred in an enclosed system in a mixture of sulfuric and perchloric acids in a ratio of 3: 1. A silicone grease had been used as lubricant on the ground-glass joints of the apparatus.

A review of the literature reveals that several explosions have been reported with perchloric acid. Nicholson and Reedy (*J. Amer. chem. Soc.*, 1935, **57**, 817–818) found that it reacts explosively with metallic bismuth. Serious explosions in steel plants are described by Gabiersch (*Stahl Eisen*, 1943, **63**, 226) and Dietz (*Angew. Chem.*, 1939, **52**, 616–618). Deiss (*Anal. Chem.*, 1936, **107**, 8–14) mentions the formation of an unstable ester in alcohol as a possible explanation of his explosion in determining potassium. Kahane (*Compt. rend.*, 1931, **193**, 1018–1020; *Z. anal. Chem.*, 1937, **111**, 14–17), working with organic material, states that perchloric acid is safe provided that sufficient amounts are used or that it is diluted with sulfuric acid. A preliminary attack with nitric acid to remove all easily oxidizable substances is recommended. Balks and Wehrmann (*Bodenk. Pflanzenernähr.*, 1938, **11**, 253–254) analyzed samples of liver with perchloric acid without incident but had a violent explosion when the same method was applied to fish muscle.

This letter is written as a warning that suitable precautions should be taken when perchloric acid is used as an oxidizing agent. It is also hoped that information will be forthcoming to establish the conditions of explosion.

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Safety and the Direction of Rotation of the Automobile Engine

The crankshaft of the usual automobile of today turns about the long axis of the chassis, and the car is driven, keeping to the right, on roads with a slight crown (central elevation for providing drainage). What are the consequences of these facts?

The result of driving to the right is that normally the automobile rides with its left wheels higher than its right. Going around a curve at a particular speed is therefore safer when turning to the right than to the left. In the first instance the car is on a road banked to aid the turn, while in the second instance the banking (the effect of the crown of the road) is the opposite, its tendency being to accentuate the effect of centrifugal force by tilting the car to the outside of the curve so that a skid off the road on a left turn becomes more likely. If the road is perfectly banked, of course this analysis does not apply.

What is the relationship of the rotation of the motor to this problem? Newton's law—action and reaction are equal and opposite in direction—can immediately be applied. Since the rear wheels are forced by the motor to rotate forward, the chassis must be pulled by the motor so as to make it tend to "rise upon its haunches" about the rear axle. This can be seen experimentally by suddenly accelerating the car from rest, when it will be noted from the driver's seat that the radiator rises. This tendency is all to the good when the automobile is negotiating a turn in either direction, since it increases the effective weight on the rear wheels, where skidding is more likely, and so reduces their liability to skid.

Newton's law also tells us that, corresponding to the longitudinal rotation of the crankshaft and torque tube, there is a tendency for the chassis to twist in the opposite direction. This can be seen by simply racing the motor in neutral with the car stationary; the hood will dip to the right, as though someone had stepped onto the running board on the right-hand side. If the motor were to turn clockwise (as seen from the driver's seat), which is opposite to the direction of rotation of *all* present-day American automobiles, the motor hood would be seen to dip toward the left. The direction of motor rotation therefore determines whether the car leans as though weight were shifted to the right or to the left side. Leaning to the right side (counterclockwise motor rotation) will increase safety on right-hand turns but reduce safety on left-hand turns; leaning to the left side (clockwise motor rotation) will reduce safety on right-hand turns but increase safety on left-hand turns. Since the left-hand turn is intrinsically more dangerous than the right-hand one, the safer direction for motor rotation is clockwise, which will reduce the danger of the left-hand turn. A shift from our present-day counterclockwise rotating motors to clockwise ones would tend to mitigate the untoward banking effect caused by the crown of our roads, thus achieving a net gain in safety.

Another more minor result of the longitudinal placement of the motor is its gyroscopic activity. Analysis of the vectors of rotation shows that with the proposed clockwise rotation the rear wheels are pressed down harder on a left-hand than on a right-hand turn, the opposite of the present situation. Thus, the safety factor contributed by clockwise motor rotation is further enhanced by gyroscopic effects. It is only in countries like England, where traffic keeps to the left, that present-day motors turn in the direction of choice.

Evolution occurs piecemeal in industry, as it does in biology. The right-handed person naturally cranks an automobile in the direction now standard because engines