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 were originally made to be cranked by hand. Today our high-compression powerful motors cannot be cranked by hand, but, like the vermiform appendix in man, the archaic counterclockwise direction of rotation persists. With the resumption of automobile manufacture for civilian use, consideration should be given to making our new peacetime engines turn in the safer, clockwise direction. The cost is negligible, since the change is only a minor engineering one. The gain, while it may not bulk large in terms of the per cent change in the accident rate, is desirable to the individuals who may thereby be spared.

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The Etymology of "Fission"

Etymological matters should be left to experts; however, as this is not done in *Science*, I should like to add a comment at the risk of seeming pedantic. In regard to the English noun *fission*, from the Latin noun *fissio, fissionis*, a splitting, I think the verb should also be *fission*. Cf. *caution*, which is both noun and verb, from *cautio, cautionis*; and *petition*, both noun and verb, from *petito, petitionis*.

Then we get the accepted adjective *fissile* (pronounced without an aspirate and dated 1661 by the Oxford Dictionary) and the new and proper adjective *fissionable*. The two are doublets, but, if *fissile* has acquired a special connotation, as J. D. Buddhue suggests (*Science*, 1946, **104**, 301), then *fissionable* is left for more general use.

The language already has *fissive* in it, meaning pertaining to fission, and many words formed on the *fissi*-stem: *fissiparous, fissiped*. Perhaps we are now ready for some more of these words.

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Pleistocene Fossils in Eocene Rock From New Jersey

For the past few years the writer has been collecting pieces of greenish and brownish stone washed up on the Atlantic beach between Belmar and Long Branch, New Jersey. Many of these pieces of rock are highly glauconitic and bear a close resemblance to the "greensand" of the Shark River and Manasquan formations of Eocene age which outcrop a few miles inland from the coast. That this rock is of Eocene age is confirmed by the presence of the typical Shark River fossil (*Venericardia perantiqua* Conrad) and the fish jaw (*Nodidanion howelli* Reed), the latter recently described from one of these stones (*Acad. nat. Sci. Phila. Not. Nat. 172*, 1946). Some of the brown stone contained typical Vincentown (Eocene) Bryozoa.

It seems logical to suppose that these Eocene formations, especially the Shark River and the Manasquan, continue eastward from land outcrops and are exposed on the sea bottom off the New Jersey coast.

It was further observed that these pieces of rock had been bored by pelecypods. At first it was thought that these were also of Eocene age, but upon identification they proved to be *Pholas truncata* Say, *Zirphaea crispata* Linné, and *Petricola pholadiformis* Lamarck—all characteristic species of the Pleistocene and Recent and not known from the Eocene. Some of the shells are imbedded firmly in the rock, while others are in unconsolidated sand within the harder rock.

Probably the Eocene rock was exposed on the sea bottom during Pleistocene or Recent times. During that time it was bored by these pelecypods, the holes then becoming filled with unconsolidated sand, partly derived from the disintegrated Eocene greensand rock. In this sand were contemporary (Pleistocene or Recent) shells. The lime from these shells gradually acted as a cementing agent, causing the holes to become completely filled, so that it is frequently impossible to recognize the outline of the original hole, although many transitional stages have been noted.

Among the Pleistocene (or Recent) species found in the fillings of these borings are *Nucula proxima* Say, *Nassarius trivittatus* Say, and *Mactra soladissima* Dillwyn. Petrified wood, thoroughly riddled by *Teredo*, was also noted.

This seeming mixture of faunas of two ages in a single deposit is not uncommon and frequently causes headaches to stratigraphers. The present mixture would, however, appear to be easily explained in the manner indicated above.

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"Container-Dent Sensitivity" of Explosives

When explosions result from rough handling of bomb-type ammunition, they generally must be ascribed to accidental fuse action because, with fuses generally present, alternative explanations appear less reasonable. But during the war there have been some explosions of items of bomb-type ammunition where (with partial detonations) fuses were recovered intact, and other cases where bomb-type ammunition items were exploded without any fuses in them. The impacts which resulted in these explosions were caused by relatively light bumping or by the items falling from heights ranging from 4 inches up to 4 or 5 feet; and they were too slight to have caused rupture or more than mere dents.

This phenomenon, now called "container-dent sensitivity" differs essentially from "bullet sensitivity" or from "fragment sensitivity," which produce detonations of explosives in thin metal containers when the latter are penetrated by bullets or fragments at high velocities on the order of 2,000 feet per second or more but are only ignited, or are unaffected, at much lower, though still "penetrative," velocities.

Also, this phenomenon is by no means the same as that involved where an even greater height of fall of a small weight is used to explode a few milligrams of *bare* explosives in conventional "impact sensitivity" tests. Its existence seems, in fact, not implied by results of usual explosive sensitivity tests, and it appears to have had little or no important mention in the literature of explosives.

Dents on U. S. bomb-type ammunition caused by impacts at least as severe as impacts causing these occa-