Comments and Communications

The Structure and Activity Relationships of the Choline Group of Drugs Determined by Measurements of Phase-Boundary Potential

The interesting paper of Ing (*Science*, 1949, **109**, 264) presents data exposing discrepancies in the proposal made by Pfeiffer that muscarinic action is produced by a spatial molecular configuration (*Science*, 1948, **107**, 94). Both authors have pointed out pharmacologically important features of the structural formulas of cholinergic substances but no mention is made of the lipoid solubility or electrogenic properties of the compounds described.

Twenty years ago, the senior author (Beutner, R., *J. Pharm. exp. Therap.*, 1927, **31**, 305) reported the outstanding phase-boundary potential of alkaloids and recently the transient potentials (waves) of acetylcholine were described (Seventeenth International Congress of Physiology, Abstracts of Communications, p. 390, 1947; Second International Congress of Electroencephalography, Paris, 1949). These investigations of the essential or electrical action of cholinergic drugs show that pharmacodynamics must deal with energy relationships and attempt to discover the mechanism underlying the relation of structure to action. We have measured the phase-boundary potentials of choline and acetylcholine and also determined the ohmic resistance of the oils shaken with choline and acetylcholine. Acetylcholine chloride, at a concentration of 0.0027 M, produced 35 mv negativity at the interface between saline and guaiacol, reducing the resistance from 2.4×10^6 to 2.7×10^5 ohms. In the same apparatus, 0.0027 M choline chloride produced only 5 mv negativity, and reduced the resistance of the oil from 2.4×10^6 to 8.0×10^5 ohms.

These data throw light on the mechanism of action of this type of drug. Acetylcholine is a stronger cholinergic drug because it penetrates into the lipoid, and because after penetration it ionizes in the nonaqueous phase. For these reasons there is a higher ion concentration in the lipoid at the site of contact with acetylcholine. This in turn entails a larger negative potential at the lipoid surface. Such a variation is the essential factor in nerve activity. Changes in these physical properties are produced by the introduction of acetyl groups in choline, as our data show. Ing assigns special significance to the size of the "cationic head" of a cholinergic drug and to the charge on the N- atom. Without doubting the justification for these assumptions, we believe that these are factors influencing ionization in the lipoid phase and consequently of secondary importance for the pharmacological effect. The influence of the exchange of ethyl for methyl groups in acetylcholine would likewise exert pharmacological effect primarily through influence on the electrogenic properties of acetylcholine, and this holds also for other substitutions.

We agree with Ing that the term *prosthetic* applies to the acetyl group. In conclusion, it would appear that the "cationic head" of Ing, the "prosthetic groups" of Pfeiffer, and the "positive charge on the central nitrogen" of Taylor (*Nature*, 1947, 159, 86) are nothing more than ionization factors in the phase-boundary potentials of alkaloids previously described (cf. Beutner 1927).

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Geological Applications of Short Range, Two-Way Radio Sets

Recent success with portable, short range, two-way radio sets ("walkie-talkie") in instruction of students in field geology suggests many possible applications of this or similar devices in educational and professional work.

The short range two-way radio, designed for voice conversation, is described in the War Department's Technical Manual No. 11-235, May 14, 1943, pp. 2–4 as a press-to-talk, portable, radio telephone, receiving and transmitting on the same frequency. The total weight of the set, including batteries, is 5.5 lb. The radio receiver is battery-powered; batteries should last about 15 hr under almost continuous operation.

Graduate field courses in geology, conducted as a part of the regular curriculum of class work at Louisiana State University, have for some time posed a problem in how to instruct these students properly in the field. These classes, in many instances, travel long distances between individual outcrops or type areas. Geologic and geomorphic features of considerable importance in student training often are present between such localities. In order to provide properly trained personnel for each car participating in these class trips, the enrollment previously has been restricted to a number sufficient to fill two cars. The increased graduate enrollment of the last few years, and the consequent increased demand for this type of course, has resulted in classes too large for proper instruction.

Recently, the technique of equipping each car with a portable, short range, two-way radio set was tried. Six cars and 24 students participated. One staff member, acting as trip leader, rode in the lead car; by means of the radio telephone he gave directions and instructions, and kept up intermittent discussions of various features encountered between the individual stops.

Signals for communication between cars were given by white flags or horns. In areas of sufficient interest, sets were kept on constantly; otherwise they were shut off until flags signaling communication were flown.

To overcome shielding and absorbing of signals by the metals in the car, aerials were extended outside the cars at all times during communication. For similar reasons, it was necessary to prevent contact of the aerial with the metals of the car.