half of the total electric moment, is silent with respect to electrode E. In contrast, segment A contributes almost double its share to the electrocardiographic output. This augmentation effect is intimately related to the proximity of the apical segment to electrode E and tends to gainsay the contention (*7*) that precordial leads are not selectively influenced by local action currents.

This study strongly suggests that in myocardial infarction the distribution of electrocardiographic potentials on the surface of the body may not be at all equivalent to that of a single cardiac dipole. If this conclusion is supported by studies at a clinical level, it will cast serious doubt on the accuracy in infarction of vectorcardiographic systems that employ a limited number of body surface electrodes, particularly when the electrodes are in proximity to the infarcted area (*8*).

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References and Notes

1. E. Frank *et al., Circulation* 12, 406 (1955).
2. R. H. Bayley *et al., Circulation Research* 2, 4 (1954).
3. The lead field shown in Fig. 1 was mapped from an equation that gives the magnitude of the lead-field current, S, through any axially symmetric circular rim. In the derivation, point E is treated as a unit point source of current. The images of E consist of another unit point source at E and a uniform line source of strength $1/R$ per centimeter extending from E to infinity, where R is the radius of the spherical volume conductor. Letting (ρ, Φ) be the coordinates of the circular rim with respect to E and a normal line passing through E, the solid angle, Ω, subtended by the circular rim is 2π $(1-\cos \Phi)$. The quantity of current through the circular rim from each point source is $\Omega/4\pi$. Current owing to a differential element of the image line is similarly determined, following which current owing to the entire image line is determined by integrating from infinity to R. Adding the currents owing to the point object and its images gives $S = (1 + \rho/2R)(1 - \cos \Phi)$.
4. H. Hecht, *Circulation Research* 3, 231 (1955).
5. R. McFee and F. D. Johnston, *Circulation* 9, 255 (1954); D. A. Brody and W. E. Romans, *Am. Heart J.* 45, 253 (1953).
6. E. Frank, *Am. Heart J.* 46, 364 (1953).
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8. This study was supported by research grant H-1362 (C3) of the National Heart Institute.

20 December 1956

Oral Incubation in Bahaman Jawfishes Opisthognathus whitehursti and O. maxillosus

Since known cases of oral incubation of eggs in marine fishes are limited to a very few families, and since we have been unable to locate any published records for the Opisthognathidae, it seems worth while to note the occurrence of this behavior in the jawfishes we have observed in the Bahamas.

In Nassau harbor between New Providence and Hog islands, there is a shallow area on the north side of the channel which has rather dense populations of the two species *Opisthognathus whitehursti* (Longley) and *O. maxillosus* Poey (*1*). The region inhabited by the jawfishes is largely of rock and white sand, with *Thalassia* beds along its inshore side, and with the urchin *Diadema* present in great numbers. There is a considerable current in the channel—so much that during tidal flow it is difficult to maintain one's position standing in waist-deep water.

On 12 May 1956 we were amassing a series of *O. maxillosus* for taxonomic study, for there is as yet some uncertainty about the proper application of the name *maxillosus.* The specimens were taken both by squirting formalin down the burrows and catching the fishes as they popped out and by placing a plastic tube over the entrance and attempting to prod them out with a long wire. One of the jawfishes collected by the formalin method was an adult specimen of *O. whitehursti* carrying in its mouth a ball of eggs so large that the jaws could not be closed (Fig. 1).

When it was transferred to fresh seawater, the fish survived the formalin and was brought in to one of the tanks in Chaplin's laboratory on Hog Island. In spite of the formalin treatment and several handlings with nets, the fish picked up the egg mass in its mouth each time handling caused the mass to be disgorged. Once when the mass lay on the bottom of the tank, it was estimated to be nearly 15 mm in diameter, almost the size of the head of the fish, but the fish took it into its mouth in a single motion. The embryos could easily be seen in the eggs that were visible in the open mouth of the fish. It was at this point, on the evening of 12 May, that the jawfish was photographed.

At some time between 9 P.M. on 12 May and 9 A.M. on 13 May, the eggs hatched, and at the latter time four specimens were preserved in formalin (ANSP 75163). During the following 24 hours, all the remaining baby jawfishes died, and the adult that had incubated them was then preserved (ANSP 75164). The latter individual (56.5 mm in standard length) appears from gross examination to be a male, although its sex must still be verified by histological study of gonadal material. Three of the other five specimens of *O. whitehursti* taken at the same time as the one brooding eggs are ripe females still bearing their eggs.

One of us (C. C. G. C.), on 9 Mar. 1955, witnessed a similar instance of oral brooding in *Opisthognathus maxillosus.* Upon capture, one of four specimens of that species, collected at the same spot as the aforementioned *O. whitehursti,* disgorged a mass of yellowish eggs that it had been carrying in its mouth. Unfortunately, only two of the four specimens were preserved, and it is not now known which of the individuals was brooding the eggs. The fact that the eggs were yellowish probably indicates that they were not far along in their development.

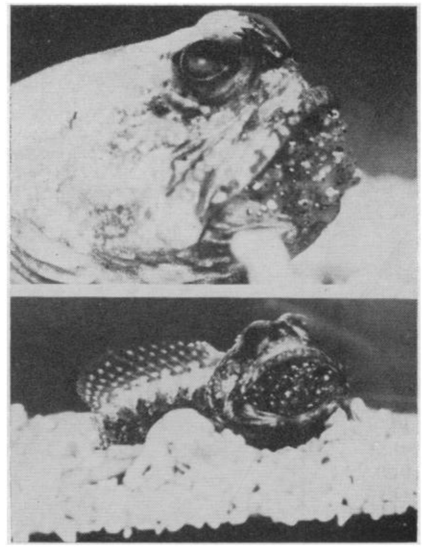

Fig. 1. Two views of the adult jawfish, *Opisthognathus whitehursti,* incubating eggs in its mouth.

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Reference

1. As determined in J. E. Böhlke, *Notulae Naturae* (*Acad. Nat. Sci. Phila.*) No. 281 (1955).

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Cytochrome c Photooxidase of Spinach Chloroplasts

Several different kinds of experimental evidence point to an involvement of cytochromes in the electron-transferring reactions of the photosynthetic process. These include the demonstrated presence of cytochromes in particles that contain the photosynthetic apparatus (*1, 2*) and measurements of spectrophotometric changes that occur on illumination of photosynthesizing organisms (*3*). Furthermore, Vernon and Kamen (*2, 4*) have described a cytochrome *c* photooxidase that is present in extracts of photosynthetic bacteria.

Kamen (*2*) has discussed the possible functional significance of such an enzyme. In particular, the presence of cytochrome *c* photooxidase can be correlated with the oxidation of cytochromes observed spectrophotometrically on illum-