

another condition of protoplasm in a muscle. It has been shown that in the sartorius of the frog there are two areas, one at each end, to which no nerve fibres are distributed, yet these ends contract with the rest of the muscle. Such a result is in harmony with the view I offer as to the power one protoplasmic unit has to originate in other protoplasmic units a similar condition.

Again, Roy has shown that the changes in calibre of the capillaries cannot be explained by changes of blood-pressure alone. No nervous elements have ever been found in them. Why, then, do they contract? By virtue of influences either from the lymph direct, acting chemically, or owing to altering conditions in the surrounding tissues. Here, again, one kind of protoplasm influences another by contiguity, if we may so speak. Each capillary cell is a representative in some sense of the *Amoeba* changing under its varying environment.

The question of *spontaneous rhythm* seems to me to throw much light on the principal problem of this paper. I have carefully studied this subject in the Terrapin, the Sea-turtle (three species), the Fish and Menobranchus. In one fish of great vitality I found a remarkable power of spontaneous rhythm in every part of the heart when isolated by ligature. As regards the Chelonians, there are marked variations in different species and even individuals, but in none was there in the ventricle a very marked capacity for pulsation independent of intra-cardiac pressure, feeding or other stimulus. I am satisfied that Gaskell's statements give a highly exaggerated notion of this whole matter. But what was very striking throughout was the fact that an extremely weak stimulus sufficed to cause pulsation in parts of the heart thus isolated; and this throws much light upon the causation of the heart-beat.

Reviewing the case, which can be but inadequately discussed in one paper, it will appear that there must be various factors entering into the causation of the heart-beat in the case of the more complex hearts of higher vertebrates.

As before intimated, the cardiac physiology for mammals is yet to be worked out along the new lines; but for reasons before given, it is likely we shall find the same factors entering into the