

the bases of the five rays, into which they send, and from which they receive, nerve-fibres; the ganglia are likewise connected with one another by a pentagonal ring of fibres. Now experiment shows that in this simple, and indeed geometrical plan of a nervous system, the constituent parts are able, when isolated by section, to preside over the movements of their respective muscles; for if a single ray be cut off at its base, it will behave in all respects just like the entire star-fish—crawling away from injury, towards light, up perpendicular surfaces, and righting itself when turned upon its back. That is to say, the single nerve-centre at the base of a single separated ray is able to do for that ray what the entire pentagonal ring, or central nervous system, is able to do for the entire animal; it is for that ray the trigger which, when touched by the advent of a stimulus, throws the muscular mechanism into appropriate action. Thus it is evident that each of the five nerve-centres stands in such anatomical relation to the muscles of its own ray, that when certain stimuli fall upon the ray, the process of reflex action leaves no choice of response. The beauty and delicacy of this mechanism is shown when in the unmutated animal all the nerve-centres are in communication as one compound nerve-centre. For now, if one ray is irritated, all the rays will co-operate in making the animal crawl away from the source of irritation; if two opposite rays are simultaneously irritated, the star-fish will crawl away in a direction at right angles to an imaginary line joining the two points of irritation. And, more prettily still, in the globular Echinus, or sea-urchin (which is, anatomically considered, a star-fish whose five rays have become doubled over in the form of an orange, soldered together and calcareous so as to make a rigid box), if two equal stimuli be applied simultaneously at any two points of the globe, the direction of escape will be the diagonal between them; if a number of points be simultaneously irritated, one effect neutralizes the other, and the animal rotates upon its vertical axis; if a continuous zone of injury be made all the way round the equator, the same thing happens; but if the zone be made wider at one hemisphere than the other, the animal will crawl away from the *greatest amount of injury*. So that in the Echinoderms the geometrical distribution of the nervous system admits of our making experiments in reflex action with very precise quantitative