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OBSERVATIONS AND EXPERIMENTS
ON THE
CARCINUS MOENAS.

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S&ANDREWS.
Observations and Experiments on the C. mænas.

Introduction.

The object of the medical faculty in demanding a thesis from every graduate is, not that he should read a vast amount on the subject he has undertaken, and then merely gather the most striking features and combine them, perhaps with a few additional remarks of his own, so as to form a concise compilation, but that he should exercise his own powers of observation and research, and thus train and strengthen those faculties on which the successful pursuit of his profession depends. Perhaps the former is the more easy, especially when the student has no inclination for pursuing the study of Anatomy (always including Comparative Anatomy), Natural History, or Botany; and this may be why so few attempt the latter subjects, while the great majority keep within the limits of Medicine and Surgery proper, concerning which, in most cases, so much has been written by others before them. It may be argued that few have the opportunity of studying Anatomy, Natural History, &c.; but, purely thus are few as situated as not to have it in their favor to dissect or observe some animal or vegetable structure, in the close scrutiny of which they may incircle their minds and benefit science far more than by confining themselves mostly to the gleanings of others' ideas. The position in which the student is placed is doubtless disadvantageous to such pursuits; between competitions, examinations, and mastering his manifold subjects, the short autumnal month or two affords little relaxation, although class attendance is over. It is not to
be supposed, however, that all those who attempt such a subject have been privileged with more time than their neighbours; in the case of the writer, the very opposite can be shown, in the brevity of his course, and the greater amount of work which had therefore to be gone through in it. It would rather seem that Medical and Surgical Themes have found more favour with Graduates than those of Anatomy, Botany, or Natural History: But it does not follow that because one writes on any of these latter Topics, he is deficient in the others; it would frequently happen that he who writes on Medicine and Surgery together is deficient in Anatomy, Natural History, and Botany.

The following observations were begun in the middle of August 1859, and carried on under peculiar difficulties, with the prospect, and soon the reality, of two years classes and their competitions in one, with Dispensary Practice and Laboratory besides. The very impossibility of experimenting on the living animals in winter, even if there had been time, almost limited this to the autumn months.

Under these circumstances, it is hoped that the few remarks here stated in regard to the Bacillus monoxenic often mentioned above may, with more thought, unfit to appear as the Thesis of a Graduate.
Remarks on Habits.

To every inhabitant on the sea coast, especially where rocks abound, the Carcinus menas, or Common Shore Crab, is familiar. But few places can equal the shipwrecking Bay and rocky promontory shore of St. Andrews, where these observations were made, for the abundance of this animal, as well as hosts of other marine productions of so much rarer description. Here the Carcinus menas is lord of the spring pools and shady clefts. Here he may be seen in some still pool whose edges and of the C. bottoms are mantled with dense algae of luxuriant growth, intermixed with lighter tufts of submersed Ceratophyllum, encrusting along some sandy spot, concealed by the vegetation, and peering coquetois stealth within the shelving rock; and he does so with astonishing rapidity. There, tide being ebb, he is found sheltering under some protecting shelf in white sand, an inch or two of his body appearing above ground, and oftentimes totally submerged, his dingly coat on ejection bearing slight current-blames to the clean mossed green which adjoins;亦 or the vegetation and coves which he haunts. Again, when the tide has far receded, and you tread over the coves which were mostly covered, in those regions where the Glaucus and Scolopa hang on the dingly dripping rocks in fantastic attitudes, now suspended by the tiny ambulacra of one ray, now by more, their gaudy bodies contrasting with the dead background of a desiccated or bunch of Glaucus. Here too, returned flake reveals rich treasures, Galathea's Being, Corellia, Arenis, Cerseilles, Subbole, Aphrodon, Myelopsis, and hosts of young C. menas; and stooping...
down you see under the ledge the well grown Doris lately feeling on one of many sponges, the pretty little Porites comprehended, occasionally accompanied by an Aplysia, while a touch of your hand brings a squint of water from numerous Anemones, some hanging from the rocks, others protruding from the sands. It may happen that you are at a point where the soft blue shell affords a favourite niche for the Chelone crispata, which here abounds, and whose fleshypipian betrays the lurking inmate of the circular aperture, and a touch on which is followed by the tiny jet of water, perhaps into your eye, and its withdrawal into the numerous retreats, which often, grooved and empty, with a projecting point at the bottom, lie covered by the waves on the sands.

But it would be endless to mention the numerous and interesting hosts which here engage as well as instruct the marine Zoologist, for they abound amongst these rocks and caves: and the apology for introducing them here is, that they are the companions of the barrenas grains in these retreats of the deep.

It is in those parts then that you get fine specimens, whose precious tales have not acquired those colossal dimensions by one mounting or by two, and numbers male or female - line the fissures, quite secure from rivets, but not as from the cold corroded iron. After a storm, especially, great numbers are found crowded together. It sometimes happened that, at this season, you ejected a group of half a dozen females, without a single male, each bearing its sub-abdominal burden of eggs. Again a large old male might be observed from some lonely nook - quite a Bachelor crab. More frequently,
however, you found a few together at low water marks, and, if single, it generally had been moulted lately, or was in the condition invariably termed 'soft back.' The females were frequently of a reddish or purplish hue, even where no eggs adhered to the abdominal feet. Lastly, he may want a telas, or several of his smaller limbs, or both, or may have them in various stages of growth, and may be subject to other mutilations, or may have several additions in the shape of a bunch of setae, a Malani, or Sponges clinging to his back, or numerous white curled derbules.

Like activity the Carcinus monen is preeminent, his body is not too long (except for his long powerful limbs); by nature he is pacific, few animals caring for his company, and he fights constantly with those of a similar sex, (of his own species), mutilating each other often to a great extent. He hangs on by a telas, when bruised, often to its destruction, but he is more cautious of the one remaining. When in danger, he elevates the telas, makes off, if not prevented, with great alacrity, whether on land, or in water; and is quick in detecting enemies. He stands in marked contrast to another of his kindred, occasionally dislodged in the search, the Cancer pagurus, whose motions do not display anything like the remarkable activity of the Carcinus on., nor is his nature so fierce. The Cancer pagurus is easily injured and dies, whereas the Carcinus on, carries great harm. The latter lives in a glass globe for 10 or 12 days, away from all moisture, but which he has in his own broaching, or comes
from those of a fellow prisoner. The Cæsars' lives last a day or two.

Towards the latter days of October the weather was exceedingly sunny, it could be observed that the activity of the l. menas was considerably diminished, especially in the morning, before the sun became strong. When pulled out of his retreat, his motions were much more sluggish than usual, showing that the cold evidently exercised a perturbative effect both on his activity
and ferocity. At Christmas the animals were in considerable numbers in the same haunt, and, the weather being mild, they were rather active. The females of course still carried their own; and frequently took their
accompanied by males in their retreats.

From the foregoing considerations, it may be presumed that the nervous system of the l. menas is highly developed and concentrated, and the consideration of this (Anatomically) brings us to the first
point of this Thesis.
Observations on the Nervous System

Before proceeding to the chief subject of the thesis, it may not be out of place to give a short description of the leading anatomical features of the Nervous System of the higher Crustacea, principally that of the Crab.

The Nervous System of the great Division of the Animal Kingdom to which Crustacea belong is characterized by generally appearing as a double gangliated Nervous chain. In the Crustacea, this bilateral symmetry is systematized in those whose dermoskeleton presents higher union with the most regular and distinct segments. It may be generally described as consisting of a series of ganglia placed on the ventral aspect of the animal, communicating with the cephalic ganglion and each other by a pair of nerve filaments, and supplying the various organs around. The Latitrus exhibits this arrangement. Further up the scale we find that the ganglia diminish, and do not correspond in number to the segments of the body. The scale of centralization is traced with great distinctness from the Latitrus, before mentioned, through the Onleus, Phyllosoma, and Hemisoma, where the ganglia have coalesced transversely to the Lobster, in which the longitudinal filaments are united completely in the abdomen, though still double in the thorax. The first thoracic ganglion and the last abdominal also are evidently composed of several united; the former being composed
of the five pairs of ganglia belonging to the five things near the accessory malacicating apparatus, the latter consisting of the two ganglia pertaining to the sixth and seventh segments of the abdomen. In the Palaemon the three lowest thoracic ganglia are united, in fact, the nervous system of the cephalothorax consists of four closely approximated ganglia. In the Palaemon the thoracic ganglia are in a single mass, with a cleft for the intestinal artery. Through intermediate stages we come to the L. mones, where the single thoracic centre is in the form of a ring, and the abdominal filament is rudimentary and single, in consonance with the state of the abdomen itself. The centralization is completed in the L. mones, where the thoracic ganglion is without aperture or break, whereas even the nerves themselves bear evidence of concentration, as several pairs are distributed conjointly to one segment.

As it is chiefly on the L. mones that the following observations and experiments have been conducted, a somewhat minute description of the distribution and structure of the nerves in this animal may be advantageously placed here.

In the L. mones, as already stated, the centralization of the nervous system is far advanced. The best way, as far as method, of preparing the crab for examination is as follows, clip off the legs with powerful scissors close to the body, except in those specimens intended for a special examination of the nerves in those organs, divide the carapace to the interior of the orbit.
† See Drawing I.
and connect the two longitudinal fissures by another
which courses transversely 4 of an inch or less behind
the palpebral cartilage. By as few from touches along
the back and sides the whole carapace can be recog-
nized on the dorsal aspect. The liver, generative
organ, and other soft parts, not necessary for its
examination, are then to be removed under running
water, with the assistance of the forceps. The body
is then to be placed in water spirit for some days;
this is requisite on account of the softness of the nervous
texture, which, being at the same time translucent, is
much the better of being so hardened before the mini-

mulate branches are traced. In those intended for
microscopic examination such preparation in spirit
is prejudicial; fresh specimens being the best.

The greater part of the nervous matter that in
this animal is found is the cephalic or thoracic
ganglia, and from these, branches are given off to
supply the organs of the special senses—those of loco-
- motion, digestion, reproduction, &c.

The cephalic mass of nervous matter is situated at
the anterior part of the cephalothorax over a deep
sinus divided into two by a prominent median ridge
and behind is a projecting spine to which a strong
ligament is attached. This sinus is marked externally
by a pale triangular surface just beneath the two
internal antennae in the median line. The gan-
glion does not lie in contact with the oesophagus
but is distinctly placed anterior to it, although the
connecting cords with the thoracic ganglion embrace
it. It is about \( \frac{1}{4} \) or \( \frac{1}{2} \) of the size of the thoracic ganglia, and together with the latter is easily distinguished by its opalescent aspect, arising from the thickness of the nervous matter there accumulated. It has a nodular appearance when fresh, probably from bunches of gray matter. This, with other ganglia, assumes a yellowish tinged after hardening in spirit while the nerve tubes have their white opalescent appearance intensified. The nerves given off from this centre are the following: Opetic, Pedal, Motor, Nerves for the internal antennæ, Antennomarginal, Nerves for the external antennæ, connecting filaments with the thoracic ganglia. The origin of these nerves are not all seen on examining the dorsal aspect of the ganglion, some being placed on the ventral surface. The most conspicuous are the Opetic and Fourth pair.

Microscopically the cephalic ganglion is a most beautiful object, and well repays observation. White and transparent though it be, fibres, cells, nuclei, and nucleoli, can all be made out most distinctly. When taken from a recently killed animal, put under the microscope, a mingled array of nerve-tubes, nerve cells, spherules, present themselves. The nerve tubes are of the usual structure, pale, transparent, and soft, yet of considerable tenacity, and run here and there apparently throughout the whole ganglion. Their ending, though difficult to trace, appear to lie in masses of nerve cells. The nerve cells are good specimens, varying in size; some large and filled
* Retina of course was continuous with the unipolar and bipolar cells.

3. See Drawing IV.
with granules, apparently the germs of new ones; others, small in immense abundance. They present a similar appearance to the same structures in ver-tebrates, having a granular aspect with a nucleus and nucleolus. A singular appearance sometimes was observed, viz. that of two nerve cells joined together by a flattened margin, similar to the Darmide, and evidently caused by the fissure of a single cell. Fibres might also be seen which from their flattened sides seem the products of the laceration of a mass filled parent cell. Some might be seen in masses, while nervous fibres coursed through over them, or were lost in the granular mass. Polyhedral nerve cells we did not see, and if they are present at all are certainly exceedingly rare. Bipolar cells we observed several times. The connection of the fibre with the cell in this animal is in a very rudimentary condition, most of the fibres seemed to be lost in masses of granular matter or cells, with no distinct connection. The primary and simple cell seemed so preeminent throughout the whole ganglion that the notion, that it must have some effect on the fibre without direct continuity, in vain could we get rid of.

If you examined the cephalic ganglion a day or two after the death of the animal, as remarkable appeared as the up-in the shape of multitudes of needle shaped crystals scattered over the field of the microscope. They must therefore have been the result of decomposition of certain of the nervous elements. They seemed of fatty origin, and
These crystals belonged to the ganglion were not extraneous structures.

* Drawing I.
Some most likely crystals of Margarins, since they resembled them most closely. They were entirely absent from newly killed specimen, neither did they appear in those kept in alcohol, which latter substance either prevented their formation, by avoiding decomposition, or dissolved them when formed. They could be detected at once by altering the focus so as to make them contrast (darker reddish) with the light colour of the transparent translucent field. Some had the shape of long needles sharp at both ends, others were twisted at one or both extremities. Sometimes they radiated from a long central stalk like a brush or fan, at others, two opposite radiations met in a single point. Acetic acid dissolved them, so did alcohol. They decidedly seemed of fatty origin, more so marked resemblance to crystals of Margarins.

The first branch of the ganglion that falls under consideration is the Optic Nerve, which, proceeding on each side from the anterior horn of the same mass, courses obliquely forwards and outwards for about 5 of an inch, then, coming in contact with the eye (peduncle), it enters the tube of the latter in company with the small irriocular nerve, afterwards to be mentioned. They do not appear to be increased in size in the Barcinas menes after they enter this tube. Passing on, keeping to the inner side of the horn tube, they plunge amongst the soft textures constituting the eye.
See Drawings VII, VIII for shape of article I & II.

A row of hairs in addition protects the small portion of the cornea not completely turned in. They are occasionally absent.
Traced to the middle of the same, this becoming more indistinct.

A short description of the Visual Apparatus will tend to elucidate the further distribution of the Optic nerve. In the *H. monas* the eyes, as in allied genera, are supported on pedicles or stalks, and are of the kind termed compound. They are moved in this animal with striking vivacity and acuteness, and are a good index to the state of the animal and its intentions. Their sockets are wide and present an admirable curve, whereby the crab enjoys an extensive field of vision so necessary to his active and omnivorous habits. In this he stands in marked contrast against with the *Pachygrapsus*, whose eyes are set in deep enamel sockets and are sluggish in motion. While the eyepockets in the *H. monas* admit of great degrees of motion, they do not render the organ defenseless, but by their exquisite curve adapting itself to that of the eyeball form the latter to sink beneath a protecting ledge. The organ is complex, and its varied movements are provision for it is completely protecting it from external injury, while still admitting of useful vision. The force with which the eye is retained, when withdrawn is very great, and it would seem that atmospheric pressure as well as muscular tension combined to keep it. When turned out, the cornea are made prominent by a revolving movement, and the more the eye
Sewing VII

See also D. VIII, VII.
is inverted (towards the middle line) the corneal prominence does it become, while at the same time it is moved in a backward direction.

The shape of the compound eyeball is peculiar, in consonance with the structure of the rest of the animal. It is a sort of cone with a deep depression extending 1/2 of its middle circumference. The peduncle, coming from the junction with that of the opposite side, enters the base of the cone towards the inner side, in a position analogous to the entrance of the optic nerve in vertebrate.

The soft parts of the eye are invested by the usual dermo-skeleton, with the exception of the cornea, which are situated at the outer side of the cone near the apex, but not quite, as part of the ordinary dermo-skeleton, forming the projecting extremity. This has its functional import, the cornea being alive, and from the danger of extreme prominence, whether in protrusion or retraction. The curves of the eye shell are various and merit close observation. But the calcareous coat of the eyeball is not of one continuous smoothness; there is a remarkable circle of hairs near the base of the cone on the outer or convex side, which seems essentially adapted to assist in the sucker power hitherto at previously. A short notice of these may not be uninteresting.

Hairs of Eyes. The circle of hairs on the calcareous coat of the eyeball, and also in other parts of this animal, present a most remarkable microscopical appearance, differing from those of any other animal with which we are acquainted. This peculiarity
* Drawing IX
of structure is not as much in the actual hair itself, (confining this description now solely to the hairs of the eyelid or the eyeball), as in certain curious appendages which admirably assist in adapting it for the somewhat odd function which it exercises. The hair itself is fibrous sparsely, with a light coloured central space which seems filled with a spongy gelatinous substance. The surface of the hair is almost everywhere clothed by growths of a fungoid appearance, some presenting the form of a floating mass attached to the surface of the hair by a pedicel, other being of a delicate, filmy, structure, not differing of a pale greenish blue, and having the aspect of faggy algae. Other hairs are thickened and conformed with a black substance, which entirely obscures the normal structure of the hair, allowing it to glance through every interval, and the dark mass appearing in striking contrast with the filmy hairs which glisten as they stretch from it. Many other forms cluster around the hair, forms of a cellular nature, some of a beautiful shape. Large, soft, fugacious or other Protozoa, as so seen as sorts of other anomalous structure of no distinct shape. The whole together making up an impervious and adhesive mass of hairs, which, with the mud particles, cannot but form an arrangement by which the compounds eyelid may be most powerfully retained in its socket. Other Motion functions may be performed by this circle, hatchet of an elastic buffer, etc.
Drawing VIII.

Drawing X.
Anatomy of comp* ey* cont. - Enclosed in the calcaneous chells lie the neural apparatus and its accessory muscles.

Cornae. The Cornae, as already mentioned, are clustered on the convex side of the apex, and this extent is well defined by the dark pigment which shins through them, and lending a bluer, glistening, and almost metallic appearance to their surface. Micr*scopecically they present the appearance of hexagonal micromergic structure of Cornes.

Plates accurately united at their margins, and this form, it is well known, admits of the greatest number being clustered in the smallest space. They are perfectly transparent, as these similar structure are no bineate, they have apparently the same texture - chemical composition.

Behind the cornae, by careful dissection, we find a mass of pigment corresponding to their in shape, and of some thickness: posterior to this the soft masses of muscles, optic nerve, nutrient arteries, etc.

The usual description given in Comparative Anatomy books of the eyes of invertebrates is that behind the Corna we find: gelatinous transparent cylinders bounded by layers of pigment, each cylinder and layer corresponding to one of the hexagonal cornal segments. We could trace the optic nerve quite easily through the mass of muscles forward to the vicinity of the pigment border, but at this, and sometimes before arriving at it, numerous branches radiated from the parent trunk, and, where followed, seemed to end in a granular
layer (formed by pressure between the glasses). This granular layer was very pale and translucent and composed of an aggregation of minute cells of somewhat irregular shape and mingled with granules. It probably was formed originally by pressure on the cylinder, the pigment having been previously dislodged to prevent obscurity.

The pigment is granular, and of a very intense bluish colour in mass under the microscope, but brownish when somewhat isolated. No hexagonal, or other regular cell formation could be detected.

In connection with the external configuration and functions of the eyeball, a diseased condition very frequently presented itself, not primarily as a defect introduced of the visual apparatus, but total disorganisation of structure and function caused by the pressure of a foreign body. This condition consists in the introduction and growth of the young of the gyllus ventriculus, the Common muscle, whereby the eyeball is wedged gradually out of its socket, and ultimately drops off, or thus projecting is removed by the tare of an adhesion. The muscles seem to have been introduced in the condition of ova, and lodged in a fissure at the inner angle of the socket, close to the insertion of the peduncle. In this position they could not be easily dislodged, whereas in growing it gave them full purchase on the broad base of the conical mass. When small, you
might be common, but after all time, one to two the few
appropriate little interactions, but in some cases, it did so as a
and, as the horrible manner, generally, the animals, to the
cular surface of the cord, after a time, disappeared by friction
broke out in a visible way; the animals, as the animals, to the
division are still in a visible way; the animals, as the animals, to the
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did I witness an attempt at the removal of this important organ. In this case a soft mass of an elongated nature grew from the peduncle; undoubtedly was an effort of nature to reproduce the eyeball. As many the socket was found quite empty, the condition probably resulting from the removal of the projecting eye by accident or the tale of an enemy, and the subsequent detachment of the muscle, zonones were found of any size in the empty pockets. While thus describing the injury caused by the illegality in the orbit of the eye, it may be stated that they occur occasionally attached to the abdominal feet of other females, of which I have found them there of lungs sized 2–4 to 1 inch in the body axis, altogether preventing the approximation of the abdomen to the thorax, and sometimes surrounded in their novel site by the ovum of the eggs. It's curious that an animal, one which, when unshelled (and probably in the state of a worm) the one mentioned with great seat, showed this frequently the source of great annoyance and injury to it.

Second pair—There are two small nerves springing also from the anterior part of the cephalic mass, and proceeding outwards and forwards, accompany the optic nerve. They also enter the tube of the peduncle, and are distributed to the greater apparatus of the eyeball.
* See Drawing I. When, however, these nerves are scarcely to be seen, as they arise from the ventral surface of the ganglion.

§ Drawings VII and XII.

† Drawing XI.
Third pair. Three nerves arise from the ventral aspect of the ganglion, immediately behind the optic and dorsal motor, and, bending forwards, enter the internal antennae divide into three branches, one supplying the peculiar organ endowed with motor branches and tactile sensibility, called the internal antennae, another courging along the inner margin, and supplying the membraneous and muscular structures around the base, and a third could be traced into the soft textures within the calcareous elevation in the interior of the cec.

The internal antennae in the B. moneas is of a similar structure with that of its immediate allies, so far as we have examined. It consists of a jointed limb with a peculiar & delicate arrangement at its extremity, consisting of two jointed appendages, one antennal strong and bearing beautiful hairs, the other slender and capable of approximation. The hairs on the larger appendage have distinct transverse markings, bearing a distinct resemblance to those of the sheep, though not as plated; it seemed as if hair of these were gentle undulations rather than deep matching. They slope to a point, but this is somewhat short without much tapering, and are of a light or straw yellow tinge. The extremity of the thicker appendage tapers much more than that of the more slender, and both are usually tipped with fine hairs. The great joints of the organ are articulated to the terminal segments of the limb, and are capable of
considerable and varied motions. These two segments are of the usual structure externally, and are articulated with the basal swelling, so characteristic of the organ, by a long ligamentous connection, which permits them to protrude or be withdrawn with great ease; acting, in fact, as a sort of elastic buffer and load, by the shortening of which the horny segments can be better fixed, and by whose elasticity softness great and delicate motion is allowed. This, of course, diminishes the power of little consequence, and increases the delicacy and sensibility, a matter of great moment. It is liberally supplied with muscles and nerves. I traced the nerves, by softening the external shell of the jointed limb, but could not detect any peculiar mode of distribution; it seemed to end in minute branches. In the beautiful terminal antennulae, no peculiar distribution was observed, though it may have been overlooked for want of time. There seemed to be no trace of nerve fibres in the terminal joints, so they appeared to be filled with pale granular matter. The hair at the tips of the third, fourth, and fifth of the side of the third one, appeared to dip in on this, and as if their every motion would affect the matter in the interior.

The basal swelling of the organ presents a remarkable structure. Outside, we have a calcareous coating dense and strong in front and edges, where exposed, but horny and yielding behind, the line of future between the two being well marked. There is a
ridge of pretty strong hairs in front. Beneath the calcarious sheath, we find the ordinary soft pigmentary layer of the derma, enveloping the glistening white sac. The sac is of irregular heart shape (like the heart of a turtle), and is firmly attached to the hard mass on its lower and outer surface (when in situ). On its under surface, looking obliquely towards the limb of the organ, is an oblong or somewhat elliptical depression, with a central fissure, which was invariably in all specimens. This fissure makes a communication between the interior of the sac and the general cavity of the organ. A process of the sac, too, juts into an irregularity of the external sheath. The microscopic structure of the membrane on all of the sacs is beautifully cellular, presenting no distant resemblance to a finely prepared specimen of the cartilage of the ear of a mouse. Every part of the membrane was composed of three cells, and they varied in size to a slight extent. Completing this membrane around the sac is a hard smooth prominence, with a ridge which runs towards the anterior. No nervous expansion is visible on the sac, only the cutaneous nerves supplying the integuments and membranes. On opening the smooth prominence, it was found exceedingly hard and brittle, and a soft pulpy mass could be pulled from this and the interior of the ridge, and when subjected to examination, it was proved to be composed chiefly of muscular tissues finely striated.
and the nervous filaments traced there before, and
which seemed to give most of their branches to the
muscles. So peculiar formation was said here to
warrant the supposition that this was the important
part of the organ, though there was a considerable
amount of nervous tissue. Besides this projection
in the interior of the sac, there is another exterior,
jutting from the deeper wall. In the hollow be-
tween the sac and the internal edge lie the muscles
and other structures pertaining to the limb of the
organ.

As to the function of this basal apparatus; there
remains no doubt in my mind but that such a
complex structure is intended for an important
end. How we have the sense of light and
hearing provided for by other parts, and since
(no part of it can lead us to think) that it has
any connection whatever with touch or taste, we
are confined to the sense of smell alone. This
pretty certain that the animals is endowed with
that sense, in whatever organs it is placed; and
since no other structure in this animal bear so
close resemblance to such (an organ of smell)
we are again restricted to this. It is certainly
in its very modified form, but this will not
exclude it from being the analogue of such an
organ. The way in which its immediate ally, the
bladder (sacculus), is caught also supports this idea
the garbage in the tracts being more accessible to
smells than light. Its superiority in activity,
and antennae of every organ, when compared with the \( C. \) \( pappus, \) would of course lead us to the conclusion that the penis are also of greater delicacy, or, least of greater antennae. It is a fact well known to those engaged in catching the \( C. \) \( pappus, \) that skunking garbage will not enter it, certainly right would not discriminate between skunking flesh bait suspended, at a distance from the animal, in the netted cage. The skunk amongst the rooks is familiar with the \( C. \) \( menis, \) which eagerly attacks his flesh bait, often to extinction destruction. From the above remarks it would thus seem pretty evident that the \( C. \) \( menis, \) possesses an organ or rather organs of smell, and that these are situated in the basal subdivisions of the internal antennae.

Fourth pair. These nerves, arising from the dorsal aspect of the ganglion, sweep outwards to supply innervation the tough membranous structures at the anterior part of the animal. They have no further function.

Fifth pair. These proceed from the centre (nervous) forwards slightly outwards to the external antenna supplying these and the special organs at their base. This basal part of the external antenna is firmly anchored to the external skeleton, and suspends the slender jointed antenna proper through the intervention of a flexible hinge, not so long
and delicate as those of the internal antennae, and
the jointed segments decrease regularly in size to thesomites.
These are endowed with great tactile sensibility
and their various motions, indicating the state of the
animal, are interesting. In danger, the crab lays
them along the lower curve of the orbits, thus shielding
them from injury. One of these antennae is frequently
swimming, which seldom happens with the internal.

**Auditory apparatus**. At the root of the great posterior,
which is firmly attached to the base of the dermoske-
leton, is an oblique and immovable plate of shell, trans-
verse in its long axis, and connected internally with
a calcareous rod, bifid at its attachment, by the
fraction of which the lid is either pushed up or
retracted. A somewhat tough membrane connects
the margin of the lid to the rim of the cavity, and
protects the important contents, as well as performs
other useful functions. By dissecting this further,
the under surface of the lid is found cup-shaped;
it moves, hinges-like, at its external end, which is
therefore somewhat fixed, while its internal end
is capable of considerable motion (fusion and
extension only). It is connected to the calcareous
plates, before mentioned, by two cornua which
belong to the rod, thus conferring on the latter
no overall resemblance to the stapes of the human
ear, at least when connected with this lid. In the
the cup-shaped hollow of the lid, or between
the fortes of the stapes, is found a pulp-soft mass
into which nerve fibres can be traced, and in which nerve cells are distinguished. It would seem that the vibrations in air or water act through this membrane on the nerve cells in the hollow. This apparatus, though it seems to be of a very simple nature, unquestionably performs the office of an ear. Various experiments and observations may prove that this animal does hear, and since there is no other organ which can by analogy be made one, the case is undoubted.

By making a noise in the proximity of the ear, hid in some narrow fissure amongst muddled water, and in such a position that sight was useless, you might hear the quaking of his shell as he pushed further inwards between the meeting pedicellae.

When a step approached the oracle, in the dark, in which they were confined in a closely fitting vacuole, an immediate commotion of the fish-swarm resulted, and the same occurred when any sudden noise alarmed them. When their eyes were removed, they also showed much more action than such an animal would if hearing were wanting and, in fact, if it were not pretty nice.

Connecting Trunks. The two trunks, connecting the cephalocele with the great thoracic ganglia, are of large size, larger than the optic nerve by much. At signs of their great functional import. They do not continue as cylindrical cords, but whilst encircling the oesophagus, as ganglions
enlargement takes place on each side, and a branching of the trunks ensues. This ganglion is easily distinguished as such, and is of an oblong aspect. It contains a collection of nerve cells, at one side of the mass, and gives off from its under side, nerves for the mandibles, and from its upper, a large nerve which covers the stomodeum with its ramifications. This latter may be termed the Pneumogastric.

Less than ° of an inch behind the esophageal ganglion have a considerable nervous cord, connecting the trunks of communication, and terminated by numerous neural folds of fibrous tissue. This cord does not arise at each side from the esophageal ganglion, but is placed ° of an inch further away. There does not appear to be any ganglion enlargement where it meets the cords, and no nerve cells were evident; it seems to be solely a commissure of fibres between the cords. From all we could observe microscopically, the arrangement of the fibres has somewhat the appearance of the fibres of the Optic Commissure in man. Some of the fibres from the cephalic centre go right on to the thoracic, others curve through the commissure; but all of them pass through the esophageal ganglion again, while a third set, not so easily made out, cross from the one cord to the other, still continuing in their fibulous direction. A similar arrangement exists with the fibres from the thoracic
Gaeflion.

Proceeding backwards under the stomach, the nerves of communication gradually converge through masses of the liver, and, passing beneath a ligamentous archway connecting the gutting portions of the skeleton, come close together to as to appear as one cords. This takes place just at the posterior part of the ligamentous band before mentioned, and then they plunge into the thoracic ganglion.

While tracing these connecting cords backwards, we come in close contact with the nerves for the foot-jaws which run forwards by their side.

Thoracic Ganglion. The Thoracic Ganglion is a slightly oval mass of nervous matter, the longest diameter being antero-posterior, and having in its centre a circular aperture. This shape gives grounds to the appellation of a 'nervous ring'; the aperture, however, is small, while the surrounding nervous substance is of great thickness. It lies on part of the muscular apparatus of the limbs, and has above it part of the intestinal canal, liver and generative system, and amidst these various organs it enjoys cons-

ervative immunity from danger. From this great nervous centre branches on all sides, to serve for the supply of the foot-jaws, tail, limbs, and abdomin, which gives to the arrangement here a cele-

brate aspect. It is best reached by a direction from the ventral aspect, whether after hardening
in spirit, or during the life of the animal. Illus-
lowered, it presents a similar structure with
the cephalic, surrounding the nerve cell so, but the
nerve cords of course are more prominent at the
edges from their great number and radiated
arrangement.
The only observation we have worthy of note in
regards to the distribution of the nerves of the limb,
is their arrangement in the young or growing
limb of the animal, when the old one has been
lost. By this means, when the limb is fully grown
are entire nerve branches transmitted to it, dif-
fering in no respect from those of the original
limb. The dissected, as very young limbs, of
an inch or less, are quite soft, no new nerves was
visible, the amputated parent trunk being little
altered; as older limbs were examined, however,
as complete nerves was easily detected. It could be
traced to the ends of the growing limb, and mi-
scopically became burried as tough fibrous
cicatric which protected the delicate parts at the
end of the stump (the latter is always of a conical
shape, even smooth). When you tried to separate
the tough cicatric with needles into its constitu-
cuts, the nerves adhered strongly and could be
detached without laceration. At the extreme
end of the nerve, a granular and finely cellular
appearance was visible under microscope, and the
fibres could be traced up to and amongst
this. Whether the nervous tissue was reproduced
by the nerves themselves, or was formed by the general cellular matrix, is a question somewhat
mysterious. We are inclined to think that the nervous tissue reproduces itself.
Operations

1. Removal of Thoracic Ganglion. This operation was effected by raising the abdomen and peeling out a portion of the shell over the ganglion, thus clearing it from the more superficial muscles of the limb. Before the ganglion was injured, the slightest irritation applied to any external part of the animal caused it to struggle violently, and, as large and active specimens were generally chosen, they were sometimes difficult to hold. The nervous matter, when cleared, is of the usual pale colour, not contracting forcibly with the surrounding tissues. The ganglion being scored with the forceps was entirely removed by snapping its branches. As each nerve was cut the limb was twitched convulsively for a second or two, and then it relapsed into complete paralysis, exhibiting not the slightest motion but such as was caused by the forces of gravity. Repeated irritations to the external surface, after a time, had no effect, and they reappeared powerless. If, however, the trunks supplying the limbs were irritated at the point of division, the corresponding limb of each nerve was flexed once or twice, and the distal segment (propriete) of ten or longer. On applying the stimulus (forceps) again to the same nerve, the movements were not distinctly unless it was applied beyond the point formerly irritated: this may be accounted for by the fact
that the forceps probably destroyed the conducting power of the excised fibres by pressure. The posterior foot-jaw was also deprived of motion, and when displaced did not return altogether to their original position, the inherent contractility of their flexor muscles not accomplishing as much. The smaller foot-jaw, however, retained a certain degree of motion, probably from the circumstance of a ganglion being situated somewhere on their nerves. The adductors of course were acting and closed sharply when forced open. The adductor for a time held a certain degree of motion (probably from some ganglionic connection too), but on severe irritation it remained extended, its distal segments alone exhibiting slight contractions. So forcefully matter escaped from the anterior branchial openings. The liver or internal antennae remained in full action, being sharply folded when extended, and undergoing other motions when irritated. When a street they were always closely doubled up and drawn in. The eyes were drawn backwards to the utmost into their orbits, and when forcibly drawn out immediately pant-breathe on removal of the restraint, unless their muscles were torn or otherwise disabled. Occasionally the animal would protrude one eye to reconnoitre, but quickly retracted it when danger seemed imminent. The external antennae were generally laid along the orbital groove, this being the least exposed and most convenient situation. On irritation, they underwent their usual motion, generally finishing off by being laid along the orbital notches again. If anything
they seemed more languid in performing their function than either the eyes or internal antennæ. Sometimes they remained standing out as if in atropea after the shock of a great an injury. By the wounds made in removing the ganglion, the heart could be seen beating, but irregularly, and always with increased vigour if irritated. Sometimes the contractions ceased suddenly, and as suddenly began again. They occasionally continued or could be excited for 14 or 16 hrs. after the operation of removing the ganglion. The movements of the heart continued for about an equal period, or the whole, after the removal of either ganglion (cephalic or thoracic); at least they could be excited for nearly the same length of time in either irritation.

In the whole these the general condition of the crab after removal of the thoracic centrum was the following: Loss of sensation and motion in all the locomotive organs (the motions which the limbs afterwards exhibited taking place when altered and removed from the body and when adherent); almost complete loss of motion of the abdomen, this, however, evincing slight contractions; loss of motion of most of the foot jaws; impairment of respiration, since no air bells gurgled to denote the active state of the branchia; irregularity of motion of the heart, with frequent suspension of function, unless under direct stimulus; integrity of function in the eyes, two pairs of antennæ, and other parts supplied by the cephalic ganglion, except as far as
might be accounted for by shock.

2. Removal of Cephalic Ganglion. This was accomplished by cutting out a portion of the shell on the dorsal aspect over the situation of the ganglion. The muscles of the stomach, cellular tissues, and other tissues were removed, and the mass exposed. The animal seemed to suffer great pain on irritating this ganglion, and their struggles were violent. It was excised, as formerly, by seizing it and snapping its branches. During the excision, the antennae and eyes, as might be expected, underwent various jerking movements, although sometimes, in the course of the operation, the animal lay in a sort of stupor during the operation.

The following effects were evident in most cases after the injury. A general stupor pervaded the animal, which appeared less marked than in the former operation, since it retained the use of its limbs. When the limbs were irritated or injured, the animal could crawl in an opposite direction, and avoided the source of pain, but there was a want of control manifested in its actions, a stumbling gait, the anterior part of the cephalo-thorax being frequently depressed to the surface on which it moved, and it often turned itself on its back. Sometimes it evinced no tendency to move, except slight contractions of the smaller limbs and raising of the toes to the site of injury, being probably from irritation of certain parts supplied by the great thoracic ganglion, as the stomach, etc., at others, it
would crawl considerably. The abdomen was very irritable, as in the normal state of the animal, and it presented interference accordingly. The fast jaw retained its motion with the mandibles, and so with the respiratory organs, as the frequent escape of frothy air bubbles attested. The larger fast jaw embodied rigorously, the smaller ones vibrating most rapidly. The heart continued to beat for a long time, as in the former case. The eye and two pairs of antennae, of course, were deprived of sensation and motion, and the former often remained protruding in a characteristic manner.

Comparing these operations with the other, it would seem that the removal of the cephalic mass had a greater influence on the regularity of the animal's movements than the thoracic, since any motions exhibited after the removal of the latter evinced more want of purpose and control than regularity. The motion could be excited in this than in the former case from the large expanse of tissue supplied by the thoracic ganglion.

3. Division of the two Connecting Cords. When these were cut the animals at once started and moved their limbs convulsively; some then assuming that peculiar position with the anterior part of the cephalo-thoracic junction downwards, carried forwards in that position; others wheeling round raised high the posterior part as as to fall on their tongues. Again, some moved little
after the injury, elevating the posterior part of the cephalic thorax, bending the forelegs underneath it, and denoting pain by biting at the oral region, then relapsing into a motionless condition with presently a twitch of a limb, the silence being only broken by the quivering air reeds from the branchial aperture. In some cases, especially if the incision was close to the cephalic gauhion, the eyes, when pulled out, no longer pushed back from slight irritation, and only were drawn in when the optic nerve was injured by direct puncture; in others, the eyes retained considerable power. They were seldom protruded spontaneously. The internal antennae were drawn and quished, showed constancy, sometimes they were even protruded spontaneously. The external showed less activity. Irritation of any of the foregoing was followed by no movement of the forelegs or limbs (smaller). The foot jaws were in full power, and the feeding mandibles of one of the small anterior pairs were often kept in vibratile motion. The large posterior pair were also often moved in the usual manner, but slowly. The forelegs retained most of their powers of motion, but lacked precision in regard to direction; the other limbs also lost little of their mobility, and there was only a want of coordination in their movements. The abdomen retained full sensibility and motion, and the slightest irritation of this part, in both male and female, caused the crab much annoyance. The distal segment was also often seen in motion, as was noticed before. A
striking effect of this operation was the tendency of the crab to turn on its back, more especially if the maxillary palps were injured by the points of the scissors, and often, although repeatedly put in its normal position, it persisted in turning itself on its dorso-lateral aspect.

Some remained midway, standing on edge with the assistance of the large forceps; these formed the points of the tripod, the third being the anterior margin of the cephalo-thorax; some did not accomplish so much, but had intermediate positions. Occasionally one died in the former position. Their attitudes were characteristic of this lesion. Often they started their limbs in a peculiar manner some time after the operation, as if a sudden paroxysm of pain compelled them to do so. Wherever these cords were divided, similar effects ensued, though most of the divisions took place nearer the cephalic than thoracic ganglion.

This operation there was followed by these general effects—Complete loss of regular progression; more or less impairment in the function of the parts supplied by the cephalic ganglion (partly from shock); power, but also stupid, in the parts to which the thoracic ganglion is distributed. That the thoracic ganglion performs the part of a complete nervous centre, when separated from the cephalic, is demonstrated by this operation. Irritation of any of the organs supplied by it speedily brought the defensive forces to that part, and with considerable constancy of direction. That the cephalic also exerts
a certain amount of influence on the thoracic, is equally plain, for, though the limbs retained motility, the animal never progressed one inch, and this was a torpor in all its motions. It did too formed as prominent feature in this operation, as indicated by the frequent motion of the forepaws towards the wounded part.

Division of the Cephalic nerves on one side. This was done by removing a small portion of the shell over the ganglions, but placed on one side of the median line. The animals generally remained stationary for a time after the first convulsive movements. In these it might be observed that it most frequently ran to the side opposite to that on which the nerves were cut. The eyes and antennae on that side were of course paralysed, and remained motionless. The anterior part of the cephalic thorax was not much depressed in general, as in removal of the entire ganglion. The animal defended itself rigorously. When the limbs were pinched sharply, the animal sometimes wheeled around and around without moving far from the spot, in a manner akin to no experiment or operation before. Some, after recovering from the shock of so dangerous an operation, moved about and generally with the sound side foremost, as before mentioned. When arrested and turned around with the wounded side foremost, and the limbs on the sound side pinched, they did not alter; but when again
Placed with the sound side first, they often decamped without irritation. When the limbs were initiated on the sound side, their motions were more sudden and lasting as if that side were the more amenable.
Experiments with Gases

1. Chloroform. The experiments with the vapour of this substance were conducted in a large glass jar with closely fitting tops, and the chloroform was either put on a piece of cloth or poured in loosely. The first effect observable was the active motion of the crab, clambering up the jar or, and apparently in some cases with evident intent to escape the rag saturated with the liquid. (Another argument for the presence of an organ of smell.)

In many of the experiments, the jar was entirely filled with the vapour, it would speedily have anaesthetised a mammal of almost any dimensions. After the chloroform took effect the animal panted into a paralysed state, every limb hanging as it died. Out of many examples, the following are interesting. In almost every instance (in all narrated below) large sized crabs of both sexes were the subjects of the experiments.

In a jar thoroughly saturated with the vapour a crab was immersed for 15 min.; its motions had not ceased when it was removed. Straw about actively and hid itself at once in a dark corner. The chloroform had no effect. Another was kept in 2½ min., when removed, cold air was applied, and it had slight twitchings. It then crawled about and acted like the former avoided the light. After 4 minutes immersion, with the usual scrambling as, occasionally one would crawl; they were generally convulsed on pouring the cold water on them, and afterwards
their limbs moved slowly at first; they recovered entirely after a time, however, as we shall see. Many one afternoon left my room door open, and then being on the floor several crabs supposed to be dead or dying, I got no small surprise when returning upstairs in the dark of evening to hear a heavy body strike on the rail of the stairs within an inch of my face which was sprinkled with moisture, this was followed by a second and a third crack in the immediate neighborhood with a plunging and crunching (as two had fallen together) which revealed the intruder. It was found afterwards that they belonged to the Chloroform jar which was supposed dead of drying (having been immersed respectively 3, 4 ½, and 6 months), but they had recovered entirely, and only one was the news of the fall. The series of phenomena in this experiment (which may be stated as follows—On first immersion the animal clambered and endeavored to escape; foot-paws in active motion both large and small; limbs gradually grew weaker and respiration embarrassed; eyes often staring, or one retracted and one staring; attempts to clear branchial apertures. In 10 mins. one or little motion, and frequently though removed they did not recover. On being violently shaken at this time, three or slight motions of foot-paws, and terminal segments of the small claws. Sometimes there was a phasmotic twitching about the 6th or 7th minute. If the chloroform jar was in proper condition they seldom recovered after the 10th or 12th min.
This remarkable agent thus has a precisely analogous effect on these animals to what we observe in man and the higher mammals. Operations of any kind could be conducted on the crabs when anaesthetised, just as in man. Of all the many experiments made with it, this is the pre-eminent, just as Conium

Sublimé among the poisons. It will be observed too that the series of phenomena occurring on its application are almost exactly those we see in the mammals. We have

first a period of stimulation, towards the end of this irregular

motion, sometimes of a convulsive character, and then a

state of anaesthesia becoming more and more intense till, at

last it passes without a sign into death.
though they might exhibit a twitch or two of the posterior in the smaller limbs after the cold affusion.*

2. Mineral Naptha. As far similar to the former was used, and the liquid poured on the bottom, or on cloths there placed. Their movements at first resembled the back, but they soon grew more violent; the animals evincing an intensity of action, its每hind being thrown about with convulsive effort. These motions lasted much longer than in the former case, those of the foot-jaws especially attracting attention, as if the animal wished to clear the anterior branchial aperture from some irritating offensive substance. It placed the animals in high degrees of excitement of spasmodic or convulsive character. If taken out in 2d and 6th hour or so, and the cold done applied, they slowly recovered. When they were kept longer, and especially if there were two together, they threw off many of their limbs, in some cases leaving only a single small limb. Their motions were very violent, but after such a catastrophe as last mentioned they were not so. There was generally little sign of life at the end of 1 hour.

3. Ammonia—With Ammonia there was only one experiment. A very large Carinax ornata was immersed in a jar of NH₄⁺ vapour, made by the evaporation
of the liquor am. fortissimum of the shape. For a time it did not move, and it seemed that the gas had a soothing effect, at least it did not cause such pain as to irritate the animal into motion. In 30 or 40
hnr the crab moved about, but this and all the subsequent motions did not seem to be the result of so much inconvenience as in the foregoing case. It continued to move till it was taken out at the end of 1 hour, quite as lively as ever, diving its forepaws with
fierce. A sudden and accidental fall put an end to this, and it lay motionless—stunned by an amount of injury which would have been trifling under ordinary circumstances. It lay with its limbs contracted in a peculiar style for 2 or 3 hours, but afterwards recovered entirely. This experiment shows some of the
preliminary effects of NH₄₂, and that sufficient time had not been given for the gas to develop its full
effects.

Hydrosulphuric acid. This gas was made by enclosing
in a perforated tin box some FeS and Na₂SO₃; the add-
tition of a little of the acid could thus always command
a supply of the gas; one only needed filling tube used.
Some of the general effects were these—The animal
often avoids the generating apparatus. There was no
violence of motion at any period of its immersion. There was no
violent of motion at any period of its immersion. There was no

of carbon of the carcase—skeleton from the deposition of
sulphur. As an example, the following case will
show how little effect this gas has on this crustacean.
comfort, and instead this inert body soon
ended at, since the animal in its free rocky haunts
is often enveloped in very stinking mud, and where
H5 forms a large proportion of the effervescence.

Large male was thus placed in the gas, and its
first motions were quiet. As placing the jar to of
the hour after, (as it was quiet), there followed re-
tilations of the eyes, the usual motions of the limbs, and
elevations of the forceps. The external antennae moved
upwards and downwards, and sometimes one eye
was retracted and again extruded, the other remaining
still. No motion of the foot jaws. Occasionally
then occurred slight clambering movements of the ter-
minating claws. It remained thus for 2½ days, with only
an occasional scramble. At this time there was bub-
bling at the branchial aperture: when shaken, tele-
feebly raised, but soon partly down again. Stated out
in 3½ days, the jar still strongly centing of H5; the
limbs were moved slightly. There were still evident
traces of vitality on 4½ day, although the crab
never stirred from the spot.

The most striking feature in this experiment was the
remarkable vitality of the crabs in so deadly a gas, which
was kept in continual abundance too by the arrange-
ment before mentioned.

Hydrocyanic acid. Hydrazine of potassium was placed
in a perforated vessel, sulphuric acid poured in,
and the jar soon filled with the HCl. On fire.
incision, the animals immediately exhibited violent motion, with attempts to escape from the deadly vapour, and spasmodic twitchings of the limbs. After this, they generally remained quiet for a time. No motion of the foot-jaws. Due in half an hour, when the new, also ceased, but not entirely. Eyes still drawn in when anything approached them; there was no tendency to General convulsions much after this, though sometimes shadow at the core. One did pretty active motion, which, however, did not last long. After the half hour. Motion slight—perhaps separation of the external foot-jaws. They died on the average in about 1 hour or 2, overcome by the fatally sedative action of the Hydrocyanic vapour.

b. Chlorine produced by the action of Hydrochloric acid on the Prussic acid of Manganese, in the same apparatus. The Crab struggled violently at first, as from a sharp irritant. The motions of the foot-jaws were slight at first, became a little more active, and then declined. Air bellowed few, occurring only once or twice. The foot-jaws often remained separate and apart from the body for a time, and the internal antenna were waving round in a peculiar manner. During the first seconds, second hour some movements of limbs and foot-jaws, and when irritated they resulted interferences vigorously. It was astonishing to witness the time these animals could be immersed in a jar, containing an amount of chlorine that would rapidly have suffocated most other animals, with no such impairment of function. The gas too must have been absorbed in large quantity by the fluids of the animal.
and diffused through its respiratory system so it was generally 5 or 6 h long. By prolife was emitted, albeit before its internal manifestation ceased. Motion throughout means of a convulsive character.

y. Sulphurous acid. The jar was filled with this, the crabs being inside, by boiling it in a capsule. After the vapors began to get dense, active motions ensued, sometimes convulsive twitchings of the limbs. At differing appearances from 3 to 1 hr, except contractions of the limbs as if from pain, and sometimes active air bubbling and flight-like. Due to the dissociating movements, and considerable action of smaller footpales, with air-bills; the larger footpale stuck out from body, and the external antennae were widely rounded. The footpale could be noticed to increasing in action after this, thus showing return of function to the respiratory organs. As swelling the jar the So₂ odour was quite gone, nothing but the colloid smell of the crabs remaining in some cases. The crabs recovered entirely from the apparently depressing action of the gas, as the eucypr and languor of motion from 10 mins. to 20 mins. or thereabout showed. The acid vapors was probably taken up by the fluids of the animal, producing a temporary effect afterwards restrained by the action of the respiratory organs. The animals, however, after undergoing this trial, were much more easily injured by external violence or other gases than those not similarly circumstanced.
8. Phosphoric acid. Only one experiment was made with the vapour of this substance. Phosphene was burned in a capsule placed in the jar beside the crab. After the usual clambering, the limbs became weaker and it sank into a quiet state, unless irritated. No action of the foot-pads, the animal feeling the irritation and closing its foot-respiratory organs. In 1 hr. motions exhibiting pain and nothing active. The dorsal surface of the crab rendered grey by a deposit of P.O. In 2 hrs. bubbling at branchial aperture. Instinctive sluggishness; 5 hrs. feeble action, when shallow, no movement of the foot-pads, and great tendency of the tentacles hanging drooping. In 4 hrs. slight motion dropping off tend to, and foot-jaws in action with frothing. The jar had long lost smell of vapour, the crab was removed. It was some time before it recovered itself entirely. In a day it crawled as actively as it had inserted, its back white with the P.O. whose acid action in a little H2O at the bottom of the jar had also reddened the terminal joint of the limbs. It lived many days, and crawled about as if nothing had happened.
Experiments with Poisons

I. Varis Emicid - This substance was introduced in poisonous quantities by various means. First, by causing a portion of shell over the cardiac region. In this, in the experiment with the frog, some observations were made on the heart. Every pulsation of the heart raised the detached portion of shell, which was carefully replaced over the wound after the introduction of the Varis Emicid. Immediately after the operation the number of beats was 90 per minute; in 3 hours afterwards 112. The animal moved little during this period but sharply presented irritation. It also emitted a large quantity of frothy matter from the branchial aperture. In 1 hour heart actions slightly increased (115); spontaneous motions slight, branchial in action. After more than 2 hours, heart beat 109. In 6 hours, it fell to 97. After the 9th hour the crab did not move except when irritated; the limbs get rigid and whole functions weak, and animal gradually paralyzed. Legs and antennae retained their irritability for a considerable time. Secondly, by making an aperture in the cephalothorax beneath the folded abdomen. The animal moved actively when fresh, and in general remained quiet for a time. Their motions soon became sluggish, and they had no tendency to move much. So frothing. In 1 hour they presented irritations actively, but did not move far. In 3 hours, presented irritation, branchial often in action. In 6 hours, when strongly irritated, moved little, but did not die from exposure; small limbs often stretched towards telea. After this they gradually
The powdered Zostera comtis was not strictly dry, as it was immediately soaked by the fluids of the coral. It must be re-
nenbered that our imperious (or nearly so) shell forms the 
covering of this animal, and removal of which we cannot 
accept to find as surface very amenable to absorption, if it 
forfay.

This may now hold, although we re-
move all the segmentary structures, as was done in every 
or nearly every case. The foreign function at least then took 
some time to develop itself in these wounds, while the main 
canal acts to work, alone.
became weaker and weaker, and perished after without many
New Carter'sinct was injected p. amum in solution and
mechanical mixture in water, the crabs moved about as usual
after being left alone, but slowly. They then remained at rest. When
irritated, struck with tongs; eyes and antennae active; no tendency
to get to secret places. In 1-2 hours struck, actively renewed
irritated; eyes and antennae functionally perfect. In 12 hr. not
much defense unless strongly disturbed. No motion beyond
the slight bearing of the cephalo-thorax, when let alone. In
3 hr. no spontaneous motion, limbs feebly; eyes still reacted
on being pulled out. At the 4th hour the eyes were seldom
retracted, and the majority were lifeless, not even twitching
of the internal antennae.
Deposition into a minute canal worse. more specifically fatal
than insertion of the dry poison almost in contact with
the heart in the one case, and in close proximity to the great
thoracic ganglion in the other. It would seem that absorption
of the solution mixed with the powder was more rapidly per-
fected on the muscle surface (acclimated to such work)
than the dry powder in the other.

II. Arsenous acid. A square portion of shell was removed
from the crabs, over the heart, a former, and again
or twice inserted. It moved about actively after the injury.
Beating of heart 60, and in 2-3 hours 76; but the organ
did not seem to carry on its function regularly, as it fre-
quently could not be seen beating at all. Branchiae in
action, but no frothy matter; resisted irritation. Internal
antennae moved jerkily. At the end of 1 hr., heart 79.
shewing slight increase. The animals were very active at the end of 3 hrs., with its rigor scarcely diminished. No 
feeling so small effect produced by such a dose of this deadly 
poison, especially when applied to the cephalothorax beneath 
the abdomen, and inserted at least a grain more of the 
powder. It crawled about as before, and seemed little 
effected by the further direct application of the poison, when 
the shock of the fatal injury was taken into account. In 
6 hrs. animals very lively and keen with forests. It 
did not crawl much from the spot after the fourth 
hour, although, as before mentioned, it was not from want 
of power. In 7 hrs. Pulse 59; eyes, antennæ, and 
limbs, pretty active. There was no frothing - but only an 
occasional quiver from the branchial aperture. After this, 
it gradually sank and died.

When the shell was injected in animo, the following effects 
occurred: The animals were immediately tetanically convulsed, 
and often consciousness seemed lost, acting crunched at the 
anterior part of the shell or anything that came in their 
way with thistled. Limbs were often relaxed for a time. 
External antennæ were crouching in a peculiar manner, eye 
pretty active, and as with internal antennæ. Foot jaws 
clenchingly moved. In 4 hours vitality in some cases in 
internal antennæ and eyes, though the crab did not 
moved from its position. No attempt to defend itself in 
any case at this time; only slight twitchings on irritation.

This poison as applied to wounds, generally 
thought to be deadly in practice, was very long compara-
tively in producing its effects. The former substance was 
much speedily fatal by this method, although it was
about equally fatal by injection. To see a crab running about almost unhurt after the manipulations narrated in the first experiment was most astonishing, and this was but one case out of many. Whenever the wound was made, the poison injected, invariably the crabs, labelled accordingly, were found amongst the list of effective after numbers of their neighbours had been killed by other poisons. The wonder of the experiment when the poison applied was to the vicinity of the heart is somewhat diminished when we recollect that the crabs can live for a pretty long time without a heart at all, as several trials showed.

8. Bichloride of Mercury. Again, a piece was placed in general in the wounds, either in the cephalo-thorax, beneath the abdomen, or otherwise. Sometimes they crawled about after the operation, but seemed labouring under some severe injury. Often the forceps were moved irregularly towards the cephalo-thorax, indicative of pain. Legs and antennae moved actively for a time. After the first attempt to escape the limbs gradually became numb and assumed abnormal positions in their efforts to propress. From its proximity to the thoracic ganglia its action might become quickly fatal in some instances, but its insertion at other points seemed that the seat of its application mattered little. The injection, in the usual manner, of a pretty strong solution of the HgCl₂ further corroborated the destructive influence on those animals. For a few seconds the limbs were most violently contorted and convulsed, and the animal raised high on its
their it generally punk into repose, and in 4 to 6 little live wave exhibited, now and now. The eyes, inner and outer and antennae point with all sense of vitality. As an agent of destruction to these animals, Convolvulus sylvestris, far exceeded other of the former substances. Killing, and did, the crabs in few minutes (10 to 15), when invited in around, while the other took many hours. By injection too it far surpassed them in activity, proving fatal in about 4 into while the other took 4 hrs.

4. Muriate of Morphia. This was introduced by the usual incision on the under surface of the cephalothorax. It moved actively at first, then rested and moved alternately. As action of its foot and blue of the two exs, performed with the antennae inserted into wounds (20) was remarkable in that the crab threw off one of its legs, as rare occurrence. The limbs responded to irritation in the non-moving ones if the request position. In 2 hrs. crawled fairly well. Action of branchiae. Died not more much after 5th hour. Lived 7 hrs. When left the was injected, after the first resembled the limbs became death refused to carry it. Exs and antennae sluggish. It lived 2 hrs. A comparatively large quantity of morphia was used in each experiment, but its effect was not sufficient.

5. Cyanide of Potassium. 4 8 on of saturated solution of the key, of this again or more of the solid, was placed in the round. The animals moved actively at first, then some remained silent for a time, often with forelegs elevated as
if in readiness for an attack. In an hour they recovered
injury rather slowly, and small limbs were still trailing. They
had often a tendency to keep one position, perhaps remaining
with their backs elevated. They did not move much from one
place after 12 h, and were unable to crawl, even their
organ feéle. They propped on an average in 2 h. or
14 % or 15% in a little. To form the usual injection, the
form of a strong solution being used. At first they were about, though
in so short a time they came to rest very easily. After not
very active, in 8 or 10 h. after, motion perfect or imitation, and
the braves were very passive. In 12 h. crawling languidly
when irritated, only for a short distance. In 1 h. when
strongly irritated, moved through with reluctance, limbs feeble and
motions dull. No quivering or active effort present. In 2 h.
had slight trace of vitality in some cases in eyes and ex-
ternal antennae, but internal antennae still sensitive. Animals
soon sank.
It was curious to observe the length of time this period
took to work the crabs, considering too its extreme deadline.
When injected onto a muscle surface its action did some-
thing increased in quickness. It was much slower than
the HQ 81 in producing its effects.

6. Oxalic acid - in crystals was inserted into the wounds. The crabs
seemed entirely unaffected and crawled about as usual.
Sometimes, however, they manifested a tendency to rest at
any convenient place, if undisturbed. Generally smart
bubbling at the branchial apertures. After many hours they
were still active and defended themselves accordingly.
Some lived for a day or two longer, and some even seemed to recover, scrambling about and virtue earnest when they were found months after, mumified and labelled. It seemed to have only a slight dulling effect on the animals, at first, with further action was somewhat uncertain.

Nux Vomica & Strychnine. Nux vomica was brushed into the wounds, when the animals crawled sharply and showed pain by biting at the injured part, and showed tendency to rest if undisturbed. Defended themselves most actively on irritation. This resulted in ferocity strongly, but did not enable far, slight tussling, blunting pricking. Sometimes a peculiar raising of the cephalic thorax on the tips of the legs was observed. By 2 hrs. could crawl, and defend itself when irritated, but spontaneous motion was seldom apparent otherwise. No motion of the feet and sputtering. Signs of life in 10 hrs. in most cases, but they would part after this.

Strychnine mixed into a mixture with water was injected in the usual manner. At first, the animals made violent efforts with spasmodic contractions of the limbs. The bubbling at the branchial apertures often commenced immediately, and continued. After their first violent efforts, the animals generally remained quiet, perhaps with their limbs gripping in the air. In 6 to 8 hrs. quivering, but no spontaneous motion, and that even when irritated. After generally freely, irritable, external and internal antennae in a similar condition. In 1 hour all retained traces of vitality, some even crawled. Limbs often spasmodically
stretched, and in a free-floating. Eyes retracted in some, convex in others. Limbs twisted, they sank soon.

The tetanic effects, usually the result of poisonous doses of the foregoing substances, need by no means conspicuous in crabs at all. Stiffening so certainly were, but they were observed frequently before. It is somewhat more fatal than Tarax (emic) + bromious acid (that is, the 15% injections).

8. Benzoid acid - When the wounds were filled with this substance, very little marked effect ensued. The animals continued active, and crawled about; air bubbling. It seemed to be so very inert substance in its action on crabs as they moved hand lined along short a time with the wounds only, as with the wounds and the 15%.

9. Iodine - This was inserted in pieces into the wounds. The animals continued active; frothing at bronchial aperture. In 24 hrs., not much affected. In 6 hrs., slightly sluggish, and rested anywhere, instead of running into a dark corner. After this, they seldom changed position. Next day, plenty of vitality in eyes and antennae. Some crabs were subjected as part of tetanic contraction of the smaller limbs with a stretching of the telson. Several died in about 2 days. Action therefore slow. A considerable size of scales were inserted into the wounds.
10. Acetate of Lead. This substance though inserted into the wounds in quantities varying from 1 to 20 grains or more produced no marked effect, the animals moving rapidly as defending themselves as in ordinary circumstances. The crabs labelled PbO-Á were the best of the room for days, and many one as mummies fate were in some dark moist. From the salt water in the animal, part of the Acetate may have been changed into the Chlorides, but whether this had any influence on the result I do not know, it would rather appear not. From the following experiment salt water must certainly have been plentiful in the intestines of the animal than in its tissues.

For different results ensued when the PbO was injected on its thoracic surface. The limbs were strongly contracted, and there was no attempt to crawl. There was slight or no gasping, and the animal sank rapidly, so that in 5 or 6 hours there was only a trace of vitality in the eyes and internal antennae, and none in the limbs.

This experiment was remarkable for the wide difference between the two modes of application. By the latter method it was most deadly, while by the former it was often inert.

11. Camphor. The pelvis was used for insertion into the wound, which was made in the usual manner. A marked effect at once seemed to follow this, illusion was sometimes incomplete. After a few minutes, the crabs showed little tendency to move from the spot, although they defended themselves vigorously. The smaller limbs were less affected.
The limbs of the appeared more inelastic than usual especially the smaller. As a crab while straining at the boot, shortly after the operation, turns off the terminal segment of the first telson, an occurrence which was not noticed below, although the crab might be under the influence of poisons more speedily fatal. In this, the smaller limbs moved slightly on strong irritation, but the telson could not be used with any power in most cases. Legs and antennae also moved. They perished speedily after this.

When a solution of Camphor in alcohol was injected for a current, the operation in all cases proved speedily fatal. The animal was immediately and violently contorted, frequently some crabs bit the opposite telson. In 2-4 minutes the eyes got dull motions, and the internal antennae were extruded most significantly. Motion of the limbs on irritation ceased completely. The large post-jaw were generally forced forward in a peculiar manner, not anteriorly, but pushed from the cephalothorax toward the mandible. They inched forward, and permanently so after death which ensued immediately.

Camphor then proved a vivid poison to these animals, and without exception. The presence of the tail in the injection must also be taken into account, though the crab died much more speedily than by the injection of the alone. An injection too, the camphor must have been precipitated from its solution in all by the water contained in the intestinal canal of the crustaceans, and applied to their mucous surface in the solid form, as in the case of the mounds.
12. Alcohol (Methylated) - Many experiments were conducted with this substance introduced by injection into three animals. Its effects were marked, and, generally, were the following. The animals were generally spasmodically convulsed, and raked about, sometimes throwing off as limbs or two, more especially if excited. The motions were desperate, and the crunching of the forepaws was a common accompaniment; in some, they were stiffly stretched out. Frothing at the branchial apertures frequently great. Eyes and antennea were active. The body the crabs sometimes assumed partially, and were able to crawl about. They often assumed a defensive attitude and stretched with the forepaws, when no enemy was near. At the hour, when initially, coarsely, and cephalo-thoracic, but seldom timed from the spot. Posterior limbs seemed weakest, and all were contracted. The hypogaeo active, considerably frothing, but motion of limbs slight. After this, the effects of the air seemed to be mitigated, and though pectoral one lasted long in producing death. Care must be taken in these experiments not to confound true successful injection with injection and extravasation, which latter accident we expect of its victims in 30 minutes or two, with desperate convulsions. Some showed a peculiar tendency to turn on their backs, as was noticed when the communicating cords of the ganglia were cut, though scarcely so well marked in this instance. The crabs did not move far from their position after the 24 hour, and if they did not live as long, it is probable that extrapolation accelerated their fate, unless they saw too large. 8, 9, or more hours after, eyes freely responded to imitation, slight motion of limbs with waving
of the posterior pair. Sometimes a few hours and at
sudden no event the 2d day after this, but the greater majority
perished in 12 hrs.

The alcohol then seemed to act as a powerful stimulant
and irritant at first, throwing the crab into the most violent
convulsions and tetanus spasms, and apparently seemed to
be about to finish it at once. This was followed, however,
in general, by a partial recovery, and then a subside
into a state of quiescence, the animal remaining for the rest
of the hour dead under no depressing agent. The violence
of the motions, when exuviation occurred, may be easily ac-
dounted for by the anatomy of the parts, the smallest escape
of this fluid substance being applied directly to the great
thoracic ganglia. It is curious too, that some crabs, after
powerful ones, with the same quantity of al that produced
the foregoing results perhaps in a manner, died very quickly
after the first convulsions.

13. Turpentine. After the injection of this, the animals frequently
marched about wildly from second or two more, as if
unhurt or irked, and then remained motionless. Opposite
forces were set in motion, with wriggling, and occasional upheaving
of the cephalo-thorax. Sometimes the legs were drawn in
the cephalo-thoracic manner, the knees bent, the legs
resting on tels, and inversion sometimes accompanying with
desperate motions of the limbs; or it stood on the tips of
the forepaws and posterior, with the smaller bend sticking
out in all directions. Sometimes motions of the footpaws,
and often wriggling at the branchial apertures, eyes and
Anteriorly pretty active. 10 min. Vermicular motions of limbs, and often peculiar positions. When turned on their dorsum a few showed spasmodic contractions of the limbs. In 20 minutes little or no motion in most; the parts most sensitive being the eyes. Some showed little or no signs of life after this, indicating a cessation of breathing at the branchial apertures; yet a little more active, though they also soon ceased. The latter condition was rare. After the animal was incapable of moving, by striking smartly on the dorso lateral aspect the eyes could be made to move about widely in some instances.

Carapaces, they seemed inert and depressant (since the crab, for running a short distance, almost always came suddenly to a dead stop). In the first case, then, if the dose was sufficient, the latter predominated and the animal died quickly.

14. Mineral Naphtha. This was introduced in two ways; first, by pinching the mandibles and necis sides it was sent into the stomach by means of a glass syringe. Immediately the crab was actually about and seemed little affected. Gradually, however, they came to rest, and in about 24 hours (peculiar spasmodic motions of the limbs in the crab; progression was in most cases impossible). In 24 hours, though strongly irritated, only slight motion was exhibited. No action of feet was from the beginning. Death soon resulted. Secondly, by the usual method of injection. The animals drew up limbs spasmodically, and they remained so for a few minutes and then relaxed.
and began to crawl with considerable alacrity. In 4 of
an hour, swinging of posterior limbs, and little attempt
at progression, seemingly from want of power. By another
little sign of life, small limbs especially paralysed. Leaps
and antumns only faint traces of vitality. Very slight motion
of the large foot and towards the end, in some cases. Life
ceased to be manifested in about an hour.

By either method, mineral vapors thus seemed equally de-
structive. The vapour of this substance killed in about 1
hr. 20, so that this would appear to be the pretty ex-
act time in which this substance proves fatal to crabs.
Poison was apparent in no small degree in almost all the
experiments, whether vapour or liquid. When a depar-
table amount fell in a box containing a number of
young animals, there was an immediate commence to creep
from this especial object of detestation and death.

15. Collodion, when poured on marines and into mouth had
a very perceptible effect. The animals sometimes crawled about
for a short time, and then rested, or else they began tumbling
on their backs at once. Contractions and moaning of the
limbs occurred frequently; bubbling at branchial apertures
not often. Sometimes the limbs were checked curiously. If
the animal was not very powerful and got a good start,
it seldom moved much from the spot, but lay as if
under some severe shock, or inking life only by the
occasional twitchings of the limbs. Some died in
2 or 3 hrs., but some lived much longer, and seemed to
recover, if powerful, from the first detestative effect.
of this compound substance. The ether probably had most effect here, and some of the motions of the animals seemed driven to those in which it was given.

Collodion, when injected, had the following effects. The crabs were instantly affected, the limbs being contracted, and sometimes moved around and around. Eyes and antennæ active. After a while it caused about one third more to remain in some cases. Bubbling at branchial apertures. Stretching of terminal segments of the antennæ limited. Nothing often continued active for a long time. The animals usually died in a few minutes, one living for a day or two, though perhaps they did not move far from the spot. The grumbling and frothing on the 25th day often told of the animal's recovery, attendant to a certain extent. Some became motionless, and their limbs when they were lifted from the ground hung powerless. They often rose, crawled after this, and lived till another longer. Collodion seemed instant at first, then had some peculiar effect on the motions of the limbs, and lastly, proved in most cases a slow poison. It was decomposed into ether, and flakes of what was gun cotton, on injection, by the 45th in the intestinal canal.

16. Calchicium. (Acteon extract)—This was introduced into wounds in two specimens. The crusts, though seemingly not much affected, did not crawl far, and even when in-itated did not move many inches from the original spot. There was bubbling in branchial apertures in two hours, the eyewas irritation moved outwards in
marty, and motion in the external and internal antennae.

No motion of the foot-jaw. They were unable to move
from spot, at least no attempt to do so. At 4 h. only
on irritation, only traces of vitality and one soon
disappeared; the other lived a little longer. Senduhium
very pretty active in itself.

14. Atropine - Atropine was injected in the usual manner
into two crabs. One ran about as if nothing had hap-
pened, and was exceedingly fierce in using his forelegs, striking
at any approaching object with great alacrity. The eyes of
both antennae acted, even more than usually. Another
was convinced at first, but by and by regained and used
his forelegs also actively, but did not move far from spot
eyes and antennae acted. The third, with the latter parts
in similar activity, did not move farther, but crawled
more than the former. Did the first act still, and
moving about in all directions; the B not so active,
but still (as very vigorous; a somewhat similar. The
two latter were obviously dull, with no tendency to
crawl unless irritated. In all there was bubbling and
frothing at the branchial apertures, and this continued with
intermissions. They all continued active for many hours,
for 16 hrs. two dead, and the other (first above) very
slightly, with most motion in eyes and antennae. It too
soon followed the other.

It should have been mentioned above that Atropine was
used in the form of a solution in water, and also mechanically
mixed to increase its strength. Its action was poison
Warabi oil oozes (from these 3 spots at least) took very virulent. A stronger solution in ether medium than the might have different results, although from the mechanical mixture the strength of the liquid was much increased.

18. Cannabis indica. (Aqueous extract).—The wine placed in the usual vessels, generally on the under part of the cephala-thorax. The animals manifested no spasmodic action. The motions did not amount to a materially weakened, and they crawled about, but were not difficult to stop, when they remained quiet for a time. Eyes and antennae active, or, on slight, gurgling at branchial apertures, not was these motion in foot-jaw, which remained in citis. In 1 hour active as before, and gurgling had commenced. They continued in a similar state for many hours, with only a slight drolling visible. The round must be taken into account itself of course. Some lived 16 hrs. others about 2 days. When tuned on their backs some were liable to spasmodic actions of the small limbs. It was observed in all the different sets that females were more liable to this than males, some assuming the contracted state without irritation or injury. This substance, though slow, proved an agent of destruction to these animals. There were no spams until near the end of the animal's life, and at this time they would probably have occurred independently of any such administration.
19. Stramonium. (Alk. extract) This was pushed into the wounds of two crabs (male and female). There appeared no visible effect at first, as the animals moved about as before, though as usual they rested more easily. Their action became duller, and they had not much inclination to move. So gurgling or frothing. Eyes and antennae became duller, the internal protruding characteristic. Two males were thus similarly treated, and the combined effects were as follows. In only one of the crabs, and which was gurgling before the operation, did gurgling continue. Six hours after, animals were sluggish and little able to move, and the foot-jaws were much more irritable than either the eye or antennae. Its movement at branches. Two died in three days in this one in three, and one retained a trace of vitality next day (12th after). It was a female. This poison then was moderately active, so far as can be judged from 3+3, and produced mainly as sluggishness when applied to the crab as above. Its pain seemed to be caused by the stramonium.

20. Digitalis. in solution +mixture in ++ was injected as usual. The limbs were immediately contracted and doubled up. Frothing began and became intense; eye and antennae dull. The animals seemed in great pain, some moved casually from the spot, and held that peculiar position with the forelegs protruded in and supporting the elevated cephalothorax. Frothing was generally great; others crawling a little. Increasing,
arrested, their limbs being retracted and unfit for steady progression. In an hour no attempt at motion, the animals in general remaining without signs of life except occasional swinging of the foot-jaws. Nothing had ceased before this. The animals soon sank, and all died within the hour. This poison, when so injected, was thus very speedily fatal; its action probably accelerated by its ready solubility to a great extent in water. A striking feature, in most cases, was the frothing from the anterior branchial openings.

In the foregoing experiments, injection, as above described, is preferred to the method of introducing the substance by the mouth, both from the greater certainty of operation and the greater safety to delicate instruments so employed. The subject or subjects of this Chiron are of such vast dimensions that they may be considered to be only touched on here, and safest from being exhausted and capable of immense extension. As before mentioned, our very brief period of observation was the result of a brief time, and return to winter duties put an end to such engaging work for a season.

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Description of Drawings.

I. View of the Cephalic Ganglion and its branches from a dorsal dissection. The ventral and posterior branches being the most conspicuous branches along with the great connecting cords of the ganglion. On tracing these latter backwards and upwards we encounter the dark tined cephalus, we see the ganglionic enlargement and pons gastricus branch; and a good way behind the gullet is the con-sineured cord of the connecting trunks, which are good opaque undissociated tissues. We cannot omit mentioning the beautiful heart, as mere scrutiny of minute observations, as it lies between the branchial arteries. The speciem had been in spirit for some time, which accounts for the wrinkling and swelling in these latter organs.

II. The Thoracic Ganglion with its lateral branches to the limbs, its anterior to the forejaw, and the communally cords, its posterior to the abdomen, its filaments to the various parts of that region being better seen with the help of the hooks. It may be noticed that the internal antennae are few in their ordinary position, when arrect.

III. Microscopic view in the Cephalic Gang of a recently Rilled Specimen. Fibrous cells in various forms, pigment, etc., all appear for themselves.
IV. Tracing from the Cephalic g. of a crab which had been dead a day or two. The heart, focused crystals of mangelwurz, contrast strongly with the translucent cells and fibres.

V. View in the same ganglion where by careful dissection in a jetting specimen the ending of the nerve fibres had been attempted to be traced.

VI. The pneumo-gastric branch magnified, the arrangement of the fibres is shown, but no nerve cells are visible in this view.

VII. The eyes, external and internal antennae in their usual position, the eyes being retracted, as seen by their relation to the peduncles. This dissection is easily made by peeling off the dorsal plate and its pointed projection from the notched and surfaces.

VIII. The external shell of the compound eye, with its dark coloured corners, tiglet of hair, and beautiful curves. Perhaps the corneal margin should approach the apex.
a very little more. The eye is enlarged.

IX. Hair from corset of eye, very characteristic of their general appearance. See descript of hair, page 8.

X. Beautiful hexagonal divisions of the cornea, freed from all pigment.

XI. Terminal antennæ of the Lateral Ant. magnified, the delicate hair tipped ends, and the stronger bristles of the longer with their peculiar setting are shown.

XII. The entire apparatus of the internal antennæ shown; the lighter tinted pyramidal portion at the root of the two large segments being the mobile relative joint. It is viewed on its ventral surface.

XIII. Section and dissection of the contents of the break organs of the Lateral Antennæ. It is principally for its peculiar cartilaginous sac that the interior is here shown.
It is in the same position as in the last specimen, or nearly so, and the elliptical depression sloping to the central figure is also exhibited. This is the suprarenal organ of males.

XIV. Cellular structure of the cartilaginous ear enclosed within the bony part of the internal auditory. The whole ear is seen in XIX.

XV. Portion diagrammatic view of the commissural bands of the connecting trunks of the cochlear and other ganglia. The renal arrangement of the fibres is shown.

XVI. The caps and bivalve shell of the Auditory apparatus. This is prepared by dissecting off the muscles of from the lids and ears where a structure of this appearance is obtained, bearing a striking resemblance to the human stapes.

XVII. Large transparent crystals seen in examining as the mucus of a specimen kept for months in methylated alcohol. They resembled crystals of cholesterol.
of the margarise forms were also visible. The expanse was somewhat less. It is probable that they did not come from the interior of the pressed mace.
View of the Cephalic Ganglion and Branches from a dorsal dissection
View of the Thoracic Ganglion from the ventral surface.