AN

INAUGURAL DISSERTATION,

ON THE

Analogy between Plants and Animals.

SUBMITTED

TO THE EXAMINATION

OF THE

REV. JOHN ANDREWS, D. D.

PROVOST PRO TEMP.

THE MEDICAL PROFESSORS AND TRUSTEES,

OF

THE UNIVERSITY OF PENNSYLVANIA,

On the 21st day of April, 1806;

FOR THE

DEGREE OF DOCTOR OF MEDICINE.

BY WILLIAM F. SELBY,

OF MARYLAND,

MEMBER OF THE PHILADELPHIA MEDICAL SOCIETY.

Valisner sits, up turns her tearful eyes,
Calls her soft lover, and upbraids the skies:
For him she breathes the silent sigh forlorn,
Each setting day; for him each rising morn.
Darwin's Bot. Garden.

PHILADELPHIA:

PRINTED FOR THE AUTHOR.

1806.

TO DOCTOR SAMUEL KER,

OF MARYLAND.

GRATITUDE calls on me to name you the first on the list, of my medical fathers.....As under your auspices, I commenced my medical studies; and from your communicative talents, I have received much pleasure and advantage..... This is inscribed as a small testimony of the great regard, and friendship of your former pupil, and ever grateful friend,

THE AUTHOR.

TO JOHN CHURCH, M. D.

OF PHILADELPHIA,

THIS IS INSCRIBED, AS A SMALL MEMORIAL

OF

THE FRIENDSHIP AND POLITENESS

WITH WHICH YOU HAVE HONORED

THE AUTHOR.

TO WILLIAM SHIPPEN, M. D.

Adjunct Professor of Anatomy and Midwifery.

TO BENJAMIN RUSH, M. D.

Professor of the Institutes, Clinical Cases, and of the Practice of Medicine.

TO CASPAR WISTAR, M. D.

Adjunct Professor of Anatomy and Midwifery.

TO JAMES WOODHOUSE, M. D.

Professor of Chemistry,

AND

TO PHILIP S. PHYSICK,

Professor of Surgery,

THIS IS INSCRIBED,

AS A SMALL TRIBUTE

OF THE GREAT RESPECT DUE TO YOU,

BY

THE AUTHOR.

DISSERTATION

ON THE

Analogy between Plants and Animals.

THE similarity of some plants to animals, has attracted the attention of philosophers since the time of the ancient Pythagoras----This great and ingenious man was so deeply impressed with this sentiment, that he abstained from several species of vegetables on account of their affinity to animals. An investigation of this analogy has lately very much increased: and as science has enlightened the world, many of those dark clouds have been dispelled that have long obscured this part of nature. Linnæus and others, by tracing their similarity to animals in the identity of propagation, have thrown much light on this subject.

We will now proceed to mention a few of their most obvious analogies:

PLANTS

are organised, living bodies; they are composed of solids and fluids---their solids are composed of an intertexture of fibres, constituting their membranes, muscles, and their different kinds of vessels, circulatory, secretory, and absorbing.

OF THE INTEGUMENTS OF PLANTS.

Plants have their different integuments and layers of skin.

1st. Is their epidermis or cuticle, this is the most external.

2nd. Is their cortex, which is of a fibrous structure.

3rd. Is their liber. This is also fibrous, and immediately surrounds the wood.

These folds of skin, are to plants, what cuticula, rete mucosum, and cutis vera, are to animals, namely, to defend their internal parts, which are tender, from exposure to inclemency of weather, and to defend them from the attack of enemies; and in order to do this completely, Nature has wisely given thorns as defensive weapons to some plants that are most exposed.

OF THE VESSELS OF PLANTS.

Plants, like animals, have their circulatory, secretory, and absorbing vessels: and these have been divided into many others.

Their absorbent vessels, take their nourishment from the air, water, and earth, and convey into their systems.

Their circulatory vessels carry this fluid through their different parts and glands, and is then thrown into their secretory vessels, by which it is converted from a bland and inodorous fluid, into one that is powerful in smell, taste, &c. These vessels also secrete the different gums and resins, some of which are so highly important to man.

OF THE ORGANS OF GENERATION IN PLANTS.

Linnæus, in his sexual system, has given to plants their different organs of generation, appropriated to their different sexes: these parts in the male are called stamens, the component parts of which are, filamentum, anthera, and pollen; the female organs are called pistils, these are divided into germen, stylus, and stigma. The use of these parts we shall speak of presently.

OF THE RESPIRATION OF PLANTS.

How plants could respire, was once an idea beyond comprehension, but is now proven that plants do respire; and botanists no longer disagree on this subject, but only dispute on the part of the plant performing this very important function.

Some have contended that respiration went on in the leaves, while Dr. Darwin very ingeniously argued to prove that respiration was carried on by the corolla, or corol, and has very plausibly compared this part to the lungs of animals; however, let this question be as it will, we can certainly prove that plants do respire, and that respiration seems to be performed by several parts of the plant. It was first imagined that all plants discharged oxygen gas in their expirations, and on this theory they were supposed to add to the purity of the atmosphere; but this opinion has been ingeniously disproven by professor Woodhouse, who has evidently demonstrated that some plants discharge azotic gas.

Dr. Hales, in a series of elegant experiments, has proven that their tracheæ are also circulatory vessels. See his Vegetable Statics.

Dr. Keill, by estimating the quantities of the several evacuations of his body, ascertained that he eat and drank every 24 hours, 4 pounds 10 ounces. In the ex-

periments of Dr. Hales, the sun flower imbibed and perspired in the same time 22 ounces; so a man's food to that of the sun flower, is as 74 to 22 ounces, or as 7 : 2. .... But compared bulk for bulk, the plant imbibed 17 times more fresh food than the man: for deducting 5 ounces which Dr. Keill allowed for the fœces alvi, there remains 4 pounds 5 ounces of fresh liquor which enters a man's veins, and an equal quantity passes off every 24 hours; then it will be found, that 17 times more new fluid enters the sap vessels of the plant and passes off in 24 hours, than enters the veins of a man and passes off in the same time. See the same.

OF THE COMPOSITION OF PLANTS.

Of the composition of plants it is unnecessary to say much, as Modern Chemistry has proven that some plants possess all the constituent parts of animals, such as azote, hydrogen, carbon, sulphur, phosphorus, and ammonia. See Lavoisier's Chemistry.

OF THE LOCOMOTION OF PLANTS.

Some have supposed that the power of locomotion should be a line of distinction between plants and animals. But those gentlemen should have reflected, that there are several animals which possess this incapability; but if we should even allow all animals to be pos-

sessed of this faculty, we also find that several plants have this power of locomotion. The male flowers of Valisneria detach themselves from the parent plant, and float on the surface of the water to the female ones. See Botanic Garden, Part ii, art. Valisneria.

OF THE IRRITABILITY OF PLANTS.

If we deny to plants the faculty of irritability, of what use would all these different systems of vessels be? Nature never did any thing in vain. How would plants be enabled to perform all their different excretions and secretions, such as gums, resins, when they are deprived of irritability? If plants have life, which the greatest sceptic cannot dare to deny, how can it be supposed that life should commence or continue independent of irritability? For to think of life without irritability is impossible. We also infer their irritability from touching the mimosa or sensitive plant, which is known by every one to contract immediately.

The Dionœa Muscipula or Venus's fly trap, is a very remarkable instance of vegetable irritability. Its leaves are armed with spines or thorns, on its upper edge, and are spread on the ground around their stems; when an insect creeps on any of them, on its passage to the flower or seed, its leaves immediately close like a steel rat trap, and strangles the unfortunate victim. Having now proven that they possess

irritability, we are from this point led to one more important, which is their sensibility. Many obstinate facts appear to demand our belief in this opinion, as plants seem to have their loves. Botanists have observed, that many species of plants, both female and male, leave their parent stock and go in search of their paramours. This leads us to a very plausible opinion that plants have their own ideas. They have certainly the senses of heat and cold, and of dryness and moisture. Some plants close their petals and calyxes during the cold parts of the day; others, after suffering a long time for rain, are known to open every part of them when a plentiful supply of it has arrived, and imbibe it greedily. This cannot be explained by irritation, as that would have a contrary effect, namely contraction; and their petals and calyxes would be closed instead of being opened. And how can we explain this phenomenon, if we do not suppose it was in consequence of their feeling too much cold and dryness?

With what avidity do the tendrils of many vines, which are fond of ascending, grasp a neighbour who is taller than themselves, and frequently become disagreeable and injurious companions to their new and passive acquaintances. And I am informed that several of this species have been known to turn and change their direction, in order to grasp a pole that has been fixed near them in the ground.

If we permit them to have these different motions, and the senses of heat and cold; and as the senses, through the whole series of animated nature, are the only avenues of knowledge; and as no sense is given without a capability of receiving ideas through the medium of that sense; why should plants, possessing those organs of sense, be deprived of the faculty of possessing ideas, and consequent thinking?

With all these faculties existing in them certainly, but in a subordinate degree, let us examine how these degraded beings begin, continue, and cease to live. We have before mentioned their passion of love..... This passion excites the males and females to approach each other. That stimulus of procreation, so necessary for the continuation of all animated nature, propells them on to embrace each other. The germ of the female becomes impregnated, after receiving the Pollen, or vivifying powder from the male. The little embryo is thus wisely enveloped in its own pericarp, and is then ready, when implanted in a proper soil, to come forward in the world, and begin his career of life.

In order to examine the situation of the embryo, and to trace its analogy to animals in its fœtal state, I determined to make some experiments for this purpose, on Zea mays, or our Indian corn. But before entering on a series of these experiments, it would be

necessary to give some description of the anatomy of this grain. The parts composing a grain of this corn are four: viz.

1st. A flinty substance, which is external, being very thin at the top of the grain, but becomes gradually thicker and larger on both sides, down to the lowest and smallest end of the grain.

2nd. Is a substance soft and farinaceous, which is much thicker and wider on the top, lies under the external substance, and decreases downwards, in proportion as the former, or external, substance increases.

3rd. Is that portion called the heart, by farmers; this begins at a small distance from the top of the grain, and gradually widens towards the bottom and ends, very near the lowest end of the grain; this occupies the middle space, and shall say is placed on the anterior side of the grain.

4th. Is the part, I have ventured to call the embryo, or corcle, which runs longitudinally through the whole substance of the third portion, or heart.

On the 29th of April, 1805, I took seven grains of this corn; of these seven grains the first,

No. 1. had the lower end pared off till the em-

bryo or corcle, which terminates very near the lower end of the grain, was brought into view.

No. 2. had a considerable portion of the grain taken off near the heart or third division, by a transverse incision made through the top; and with a longitudinal incision on the side, exposed the heart, with a very minute portion of it taken off on the side.

No. 3. had the top of the grain pared off to the same distance with the last, and with a lateral incision took off nearly half the heart, with the whole substance of the grain as far as that part.

No. 4. had a considerable portion of the external substances, with the whole heart and corcle removed.

No. 5. had rather more of the external substances removed than in the last experiment, but its heart and corcle remained uninjured.

No. 6. had all the surrounding substances removed as nearly as possible from the heart.

No. 7. had nothing but the heart and corcle removed.

On the same day (29th of April), planting each in

regular order, with a stick by each, marking carefully the different numbers.

On the 12th of May the succeeding month, No.s 1 and 5 appeared above the surface of the ground, No. 1 appearing somewhat the largest; No. 2 appeared a few days after; none of the rest ever appeared. In this stage of existence, the analogy between plants and animals is strikingly obvious in the 1st and 2nd experiments, but more particularly in the 5th. As in this experiment a great part of those substances was removed, constituting what may with strict propriety be termed placenta of vegetables, while the heart and embryo or corcle was unimpaired. And in this experiment we have reason to suppose that there was a sufficiency of placenta remaining to carry an absorption for the nourishment of the fœtus: for this grain came forward as soon as No. 1, which had only a very small portion of its lower end removed; and although a larger proportion of the surrounding substances of No. 5 was removed than in No. 2, we find that No. 5 came forward the soonest: and we can only account for it but by recollecting that No. 5 had its embryo, and also the substance immediately investing its embryo uninjured, while No. 2 had but a very minute portion of its third division or heart removed, but this small part considerably delayed the grain in coming forward. And from these experiments it also appears, that the nearer we approach the fœtus, the more vital are those parts which immediately invest it.

As we know it impossible for an animal fœtus to come forward to maturity without its proper membranes and placenta: in the same manner we find it impossible for a vegetable fœtus, when deprived of these parts, to arrive at perfection; for in No. 6, we there find this little being deprived of its placenta, never to advance to perfection. And in No. 7, we might as well have expected that a placenta could be converted into a fœtus, as that this grain should come forward after being deprived of its embryo; it might with some propriety be compared to an abortion with the placenta in utero.

We have from these experiments proven very decidedly, that this 4th division, contained in the heart, is the punctun saliens embryo or corcle.

That in the 1st experiment we have shewn that a small portion of its placenta might be removed and the grain still succeed tolerably well in coming forward; and in the second experiment, that a considerable portion of its two external surrounding substances, and a very small portion of its third substance or heart might also be removed, and the grain, with some little interruption, still come forward; and that we should not be surprised at No.s 3 and 4 not coming forward, as the former lost a considerable portion of its fœtus, with a quantity of its placenta; while the latter lost the whole of its embryo, with some of its placenta. And that in

No. 5 we have ascertained, that if the heart and corcle, being unhurt, the grain would come forward, after having lost a considerable portion of its placenta. And that in No. 6, the grain, although having its heart and corcle uninjured, could never come forward to perfection, on account of its want of placenta.

And upon the whole, that plants may possibly lose more of their placenta than several animals, and still succeed in arriving at perfection; and that the fœtus is the fourth division of the grain, and that it can never be touched without injury.

We have now seen plants invested by their own membranes and placenta, imbedded in the earth, and there capable of being stimulated, even at this early period of existence, to assume the form of life, and to become perfect and well grown. We also behold them like animals, have venereal desires, so necessary for the continuation of their species. We have also seen the stimulus of hunger, thirst, as well as that of procreation, acting on their excitabilities, and these stimuli producing certain motions and contractions; as they have an excitability, stimulus acting on this excitability, must produce the motions of life....this excitability is at all times capable of being exhausted by stimulus....life must be in them as in animals, a FORCED STATE. If then stimulus, acting on excitability, produces life, a due proportion of their excitement and excitability

will constitute their perfect health; and if at any time this balance is lost, disease or predisposition to disease must be the inevitable consequence.

For example, if too much stimulus has acted on their excitability, violent or morbid excitement is the consequence constituting their forms of disease, termed, inflammatory, or of too much action.

These forms of disease are exemplified by their exposure to violent heat, as when they are too strongly stimulated by the scorching heat of the sun, in a dry summer; or from an evaporation of strong nourishment given them in the form of green and stimulating manure. Their surfaces appear red, dry, and parched, having in fine every symptom of fever. The cure should be as with animals: abstract stimulus, moderate excitement, by cool air, cold and diluting drinks; this is done for them, very fortunately, by a happy shower of rain.... Plants have, in common with animals, their opposite forms of disease: when growing in dark and shady places, they have been observed to be pale and weakly, on account of their want of the grateful stimulus of light and heat, a stimulus by no means inconsiderable in the animal world. In this case, as with animals, restore the usual and required stimulus.

Give them tonics and stimulants, in the forms of the different remedies, termed by the farmers, manures;

but we should take care to begin with small doses, if their excitability is much accumulated, else we elevate their excitement too high; for plants, when suddenly cooled by a shower of rain in the summer, have their excitabilities very much accumulated; and if the sun begins to shine with its usual warmth and splendor immediately after the rain, they become parched and burnt, in consequence of their violent excitement. Plants are also subject to disease in its many various forms, called by the farmers, rust, scab, &c. They are subject to their disorders or local affections....these are exemplified in blotches, specks, &c. On a proper knowledge of their many various forms of disease, rests the whole science of agriculture. And here a large field of useful inquiry is laid open for some happy experimenter. And I make no doubt, but that period will arrive, when we shall learn to prescribe, with as much advantage for a sick plant as for a sick person.

We have now considered plants in their fœtal stage of existence, and advancing from that state like animals to their proper growth, and then to answer the purposes of their creation, by providing themselves with successors; and then to make their exit....Death the common lot of man, as well as that of every other animated being, must be the consequence of the same causes in plants as in animals, namely from an exhaustion of excitability, or from a want of excitement.... Man and other animals, bring on their disease, fre-

quently by an improper use of their different appetites and passions. Botanists have observed, that plants when deprived of the faculty of fœcundation, are apt to live longer....Probably like some animals, they are too much disposed to venereal pleasures, and often curtail the span of their existence, by immoderate sacrifices to the votaries of Venus. Like animals, many die as soon as they begin to live. Myriads of them, as soon as they raise their heads above the surface of the earth, are destroyed by the mouths and feet of many ravenous animals; while other promising little sprouts, bidding fair to be the monarchs of the forest, have fallen premature victims to the overtowering hand of man.

After tracing plants from their most early period of existence; considering their many various faculties, motions, and senses, where shall we draw the line of distinction? This line cannot yet be drawn; but that time probably will arrive, when this long sought for boundary shall be discovered.

With what order and uniformity do the laws of nature exist, through the vast fabric of creation, every part thereof plainly demonstrating that we are all the offspring of the same parent.

THE END.