



## Philosophical Transactions

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*Martini Liſter è S. R. Lond.*  
**DE FONTIBUS MEDICATIS ANGLIÆ.**  
*Exercitatio nova & prior. Eboraci. 1682. in 8º.*

**T**He most rational way (in the Opinion of this curious and judicious Author) certainly to know what the *Saline Content*, to be found in the several Waters in *England*, are, is to Crystallize them.

This Crystallization is to be done with great care and Accurateness, not at once in a Lump, as it seems most have been satisfied with; But after many Experiments, Ablutions, Dissolutions and Shootings till you have the whole Mass of Salt fairly and singly cristallized.

Then to compare these Crystals, with the Crystals of all the known fossile Salts; to which end these known Salts also are to be exactly described from their fairest Crystals: All which he hath carefully done, described, and figured.

But if it shall be asked why so many figures of the Salt of *Nitrum Calcarium*, and but one of the rest; is answerd, not that he judges these different species, but only he gives most of the Varieties, in which it is wont to shoot; not but that all the rest of the kinds of the figured Salts give as great a variety of Crystals, but he thought them well enough known, that he might spare himself the trouble and that it would be sufficient to give the Compleatest.

Now amongst the *Saline Contents* of all the Medicinal Waters which he hath either tryed or read of, he finds only two; *viz.* The Crystals of a certain niter of an uncommon figure and of common Salt; and these two only; not questioning, but that there may be Waters in *England* which naturally hold others, but he hath not been so happy as to meet with them; no not in those ve-

ry waters, in which some of our own writers so boldly assert them to be contained.

As for the Earthy Contents, he finds them also to be two only; *viz.* *Brown Ocre* (which is a term of Painters to distinguish it from *Yellow Ocre*) this being a sort of Iron Ore, and *Lime-stone*. Now to demonstrate this as matter of fact: that these Earths were such and no other, he hath at large described all the several sorts of Iron Ore, which he hath met with in *England*, and the true way to know them by the Loadstone. And in this History he hath shewn that the *Pyrites* is but one in *England*, and that meer Iron Ore, under what name or figure or disguise soever it comes before us. In like manner he hath given the true Notion and Character of *Lime-stone*, which also he might have at large described according to the several species he hath by him, which possibly he may do when more at leisure.

Now how these Earthy Contents and Salts come to be mix't in the Water, and what relation they have one to the other, you shall thus understand.

All Iron Ore, but more especially the *Pyrites* (which is every where and in all places of *England* plentifully to be found, at least *sparsum* and in lumps or *Glebe*, and some places in Beds) Also all *Limestone* (which is the great bodie of most of the Mountains and Rocks in *England*) if moistned and wet, as they must be where they are cleft, and give way to the soak and subterraneous current of Springs; both these he says, moistned, naturally shoot there Salts.

Now the Salt of the *Pyrites* or Iron Ore is *Green Vitriols*; and the Salt of *Lime-stone* is the Nitre by him described.

That these Salts are shot not instantly, and as in their *Crytallization*, or by *Coagulation*, or *Corrosion*; but by a leisurely and natural growth or *Germination* analogous to that of Plants or Animals.

That therefore the life of these growing Salts is in like manner halituous and naturally Warme, and may if copious

ous and streightned in their *Exit* become hot, tho not actually inflamed ; whence the *Thermæ* or Hot Baths.

That the shooting of these Salts under Water must necessarily be imperfect, because I wash off before their full growth, and that therefore no mature *Vitriol*, has yet been found in any *English* Spring, that he knows of.

That from the shooting of these Salts arises a Vapour of the whole bodie of the Stone, in like manner as Wood or Plants are known to steam out their whole and intire Rosin into the Air.

That therefore these Vapours only Petrifie ; because they easily penetrate as Spirits ; and also at the same time lodge themselves where they penetrate, as intire Substances.

In handling of these matters, there are some other particulars, which are new, and for which you are referred to the Book it self : As the notion of the *Pyrites* ; The Crystals of *Rock Niter* exactly described and figured ; that all *Lead Ore* is naturally *Silver Ore* ; Way of distilling the Sea Water into a potable & fresh liquor by Sea Plants &c.

JOH. ALPHONSI BORELLI Neapol.

Math. Profes. opus Posthumum : Pars prima,  
Romæ 1680. pars altera ibidem. 1681.

**T**He former account of this work being general and modest, most of it what the Author himself gives in his Preface to the Book not then published, and a promise having been made of a more particular Relation of the Contents of it, as it well deserves; to cancel that Obligation (tho not made by this Publisher) the former account is here enlarged, as follows.

*First*, He gives an exact Description of the *Muscles*, which within its *tendinous* or *Nervous* membrane contains several small bundles of Fibers, which constitute an *Hexagonal, Square, or Triangular Prism*. The Fibers themselves in each *Prism* being *Parallel*, and variously connected to each other. The *Microscopical* appearance of a single Fibre representing a *Cylinder*, not hollow like a *Reed*, but full of a spongy pith like *Elder*.

He gives an account of the several Species of *Muscles*, from the position of their Fibers, and asserts their proper action to be Contraction, adding a modest but solid censure of *Steno's* structure of a Muscle. and manner of its operation.

He confutes the common opinion, That Nature with a very small force lifts up the greatest weights; the contrary being demonstrated, That the *power* does a 100, or 1000 times exceed the weight of the limbs that are lifted up by it: and this is the cheif Subject of His first part.

To prove which He premises this Proposition; That the flexive motion of a joint is Sphærical or Circular, or made on a Conical superficies, about an imaginary center. And laves down this general Rule to distinguish them by,

*viz.*

*viz.* Whensoever the motion of a bone may be made about one fixt point, that motion will be Spherical; but when the motion must be about two Poles, or an Axis, that is necessarily on a plain Circuler Superficies, or a Conical one.

To shew the strength and *Momentum* of a Muscle, He premises some propositions about the *Vestēs*, which he applies to most of the chief Muscles of the body.

He gives us likewise an account of the wonderful structure of the Back-bone, to the *Cartilages* of which he attributes a greater force than to all the Muscles that contract it, as is evident from this proposition; That if a Porter carry on his back a weight of 120 pound, the power Nature exercises by the *Cartilages* of the *Vertebrae*, and the *Musculi extensores* of the back is equal to the force of 25585 pound: that of the Muscles alone he computes to be 6,04 pound, and observes that the Retention of a joint stretched out is not from the Tonical action of Antagonist Muscles.

Hence he goes on to deliver the various postures of an *Animal*, which he does by assigning his Center of Gravity in all his possible positions. As in a Man stretched out at length, the *Center* is between the *Nates* and *Pubis*. That a man cannot well stand one one Heel, or the tip of a Toe, because in these cases the *Line of direction* falls without his *Basis*, &c.

That tho Birds have two feet, yet they neither walk nor stand the same way as a Man; which depends on the different structure of their joynts. For First they differ in the number of the Bones. 2. In the Form. 3. In the distribution and make of their Muscles. 4. In the Joynts themselves.

He demonstrates the manner how a Bird when sleeping sits firm on a twig, tho the Muscles are then unactive; namely by a strong constriction of its Claws, and consequently a firm comprehension of that Twig, necessarily and Mechanically resulting from the gravity of the Bird, and the shortness of the *Tendons* of those Muscles that contract the Claws.

That

That *Quadrupeds* cannot stand in their natural prone position on one or two feet, because the Center of Gravity, and its line of propension cannot fall in either, or between both.

The reason why in ascending or descending Stairs in the dark, when we expect one more then there is, the extended foot is dashed with violence against the Pavement, *viz.* In the first case the Center of Gravity and Line of Propension, are carryed forward beyond the foot that's fixt, so that the suspended foot, not meeting with the support expected, a motion downward is necessarily caused by the gravity of the body, according to that line, which is not a step, but a fall. In the second case, the Muscles of one leg are contracted, and lengthned in the other, but both these motions being checked by the unlookt-for resistance of the Pavement, the like sensation is caused with what we feel when we stamp on the ground.

He shews the Art of *Scating* upon Ice, as also how progression in *Quadrupeds* is performed, and likewise *Leaping*, in which the *vis motiva* is to the weight of the body as 2900 is to 1.

That in *Leaping* according to a line inclined to the *Horizon*, at oblique angles, the line described by the center of gravity shall be a *Curve Parabola*, as being compounded of the streight uniform motion forward, and the accelerated descent of the Heavy body.

Next he gives an exact account of flying, the main stress of which is in the largeness of the muscles that move the wings, the *Potentia* of which exceeds the weight of the bird 10000 times; with many more curious particulars about their several wayes of flying.

Hence, he concludes the impossibility of the *Artificial* flying in Men, for neither can their pectoral muscles be enlarged, nor the weight of their bodys be diminished, tho attempted by an exceeding thin and large, exhausted receiver of Metall; for it must contain a space equall to its own weight and that of a man fastned to it, which would amount

mount

mount to at least 2000 Cubick feet, besides many other absurditys.

He describes the action of swimming, and how fishes change their specified gravity on occasion, by the compression and dilatation of the Air contained in their *Air-Bladders*, performed by the many and strong muscles about their bellies.

He assigns the reason why man does not Swim by Instinct, as well as other Animals, to be chiefly on the account of the gravity of the head so much exceeding the proportion of that of the rest of the body.

The several ways to live and move under Water were described before as the *Bell*, the leathern *Cylinder* &c. but that which he seems most to insist on, is of a Brass or Coper *Vesica* about two foot diameter to contain the Divers head, this to be fastned to a Goats skin habit fitted exactly to the shape of the body. He contrives a *Circulation* for the Air by pipes within the *Vesica*: and bestows on him an *Air-pump* by his side, by which he may make himself heavier or lighter, in imitation of the engines Nature has given to Fish for that use. By this means he avoids the objections the others are liable to, particularly that of the Air, the moisture by which it is clogged with in expiration, and by it made unfit for the same use again, being here taken from it by its *Circulation* through the pipes, to the sides of which it adheres, and leaves the air as untainted as before.

He concludes the book with a description of the diving Ship, The motion of which he conceives would be much facilitated by one single oar in the Poop, which should be flexible, & made w<sup>th</sup> a spring, from the vibration of which the ship should be impelled as Fishes are by their Tails.

In the second part he compleats the Doctrine so well begun in the first, and layes down the Mechanical Mode and immediate cause by which the contraction of the muscles is performed.

In the First place he shews why a Muscle cannot be moved



any of the different ways of motion in other things. That it is not contracted by the simple traction of its Fibres, as weights are drawn up by Ropes, because the length of the muscle would no more be shortened than the length of the rope is, the contrary of which is evident to sense. Neither are the Fibres bent like a bow, nor do they act by the removing any impediment by command of the *Animal* faculty, because such force being internal, there would be required almost as much pains to *Rest*, as there is to *Motion*.

They are not likewise hardened by the bare Rest of their parts, nor contracted by drying, as we see Hair, Skins, Leather &c are by the Air. Neither are they wrinkled into folds as *Reptiles* are in their progressions; the corrugation of which He demonstrates to be not the cause, but the Effect of the contraction of their *internal* muscles.

After all he concludes that the muscles are contracted from the *inflation* of their Fibres by adventitious bodies, as it were by wedges. And having refused an Incorporeal natural faculty for the immediate mover, as also any aerial Substance, and rejected the blood filling the pores of the muscles, together with the manner by which moistened Ropes are contracted; He concludes That the Ebullition, caused in the Muscles by the concurrence of the blood and *Succus Nervous*, is the immediate cause of their intumescence and contraction, which he confirms and illustrates by arguments and Experiments.

He proceeds to give an account of the internal motions of the fluids of the body, as of the *Circulation* of the blood, and how it is continued, though it seems to be interrupted and broken in the Heart.

He demonstrates the manner how it is moved forward in the *Veins*; especially by the help of the *Valves*, which he observes to be not single membranes, but small hollow bladders, whose *convex* ends respect the capillary extremity of the veins, and their *Orifices* open towards the heart. He relates likewise the musculous structure of the Heart, and how it differs from other muscles by the wonderful texture

texture of its fibres, whose *Prismatical* columns are not separated from the membranes and tendinous fibres, neither is their disposition *direct* and *parallel*, but *curve* and *spiral*; and that too in a way far different from *Vesalius* his wicker-baskets.

And at last concludes that the moving facultie of the Heart doth exceed the resistance of the whole blood in the Arteries, and of the ligaments that hinder their dilatation, which is greater than the force of a weight of 180000.

He ascribes Respiration wholly to the muscles that enlarge the *Thorax*, (*viz.* The *Intercostalls* and the *Diaphragme*) together with the weight and elasticity of the Air. The manner, by drawing up the circumference of the Ribs towards the Throat, by directions that make acute Angles with the Planes of the Ribs.

Remarkable is the structure of the *Thorax* in the *Tortois*, which hath no divided ribs, but one continued bony arch, and no *Diaphragme*; and instead of Lungs, two long bladders containing also the blood vessels. These baggs are not alternately filled and emptied, but constantly remain full of Air, which is not renewed in them but partially, by the external muscles that stick to the Skin which when unactive make an hollow *Sinus*, but contracted a *Plain*.

The use he assigns to respiration, besides the dissolving of the grumous concretions of the blood by dividing it into minute Particles, is the mixing the Air with the blood, which neither increases the fluidity of it, nor causes any effervescence in the Heart by its *Elasticity* or *Nitrous* nature, but supposing the particles of the Air to be spiral flexible machines, they must be compressed by the weight of the Ambient *viscera* and vessels. But the fluid and solid parts of Animals being moved a Thousand different ways, these springs conceive a motion like that of a *Pendulum*, which gives a tremulous motion to the blood, and continues it till the death of the animal, that being its *vital Motion*.

The Nutrition of Plants he explains by imagining an

an engine so contrived by various tubes terminating in due places of a table, that any figure may be delineated by the bare injection of Liquors, without any other art.

In his use of the Liver he asserts the *circulation* of the *bile* in the *Abdomen*, and explains the manner of it; as also the motion of the *Succus Nerveus* and the *Semen*; which is not so properly a *Circulation*, as a *Flux* and *Reflux* of it, because he assigns the same vessels for the ascent and descent between the *Testes* and the *Brain*.

He confutes the *Vulgar* errors about the *Torpedo* and *Porcupines*, and gives his own experience that the first acts only by a Tremulous motion strongly impressed on the hand that toucheth it, especially in that part of the *Thorax* toward the back-bone where there is a concourse of abundance of Nerves and Muscles. And adds this circumstance, that when with his finger extended He obliquely toucht the *Thorax* of the Fish, he suffered nothing; but if with his finger bended he received perpendicularly the vibrations of it, then he was affected.

That the *Porcupine* does not shoot out its *Spicula*, but by keeping them erect doth shake and brandish them by the help of its Muscular outward Skin, and the *semi-lunar* Muscles with which the inner Skin is accompanied, which erect and shake the roots of those Spicula.

Lastly he treats of the *Causes* and *Cures* of *Feavours* and their differing *Paroxysms*, which being wholly *Medical* we leave to the Knowledge and Experience of the *Physitian*.

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