

(19)
1170
*Compliments of
The Author.*

ALBRECHT VON HALLER:
SCIENTIFIC, LITERARY, AND PÔETICAL
ACTIVITY.

By JOHN C. HEMMETER, M. D., PH. D.

name books.

I) Albrecht Haller

Tagebüchen einer Reisen nach

Deutschland - Holland und England 1723 - 1727

herausgegeben von Ludwig Kugel - Leipzig Ant. S. Kugel 1853

This is the autobiography of the adolescent Haller - and if
as you say you admire his poetry - I must emphasize
that it was the young Haller who was the poet - not the
old mature Haller - Harvey Cushing who worked at
Bern a long time with the Surgeons there - studied
Haller's tracks & found references to these "Tagebüchen"
but never a copy of the book itself. You must read
his impressions of England. - I have the book. it is
extremely rare.

II) Jahres und Cato - Ein Stück der Römischen
Geschichte von Albrecht v. Haller

II Jahres und Cato - Ein Stück der Romischen
Geschichte von Albrecht v. Hallen
Bern und Göttingen 1774 (5 books)

III Alfred König der Angel Sachsen
von Albrecht von Hallen

Frankfurt u. Leipzig 1774 (5 books)
dedicated to George III König von Gross
Britannien etc etc

My first acquaintance with Hallen was through my magnetic
teacher H. Russell Martin. Ten years during the winter semester he
had his graduate students at his home every Friday evening. In that
group were men like Fredk S. Lee. H. A Donaldson - W. H. Russell and
we took turns at translating Hallen's "Elementa Physiologiae" those were
most delightful days when Martin was in his prime & Mr Martin a
splendid hostess & admirer of classic music. Happy student days and
grateful memories of master teachers!

bern, [65]

the
ding
table
was
rva-
in-
ave
was
ter
at
on
ta-
ou-
vig
ood
er-
itic
the
ller
a
n."

Dear Dr. Keller

22

Your most kind and interesting letter of Dec 29th is well
The most talented thinkers in diplomatic circles in Washington
are convinced that time and events are mature for diplomacy
to assert itself. Some of these diplomats are or have been
patients of mine - for - the most gigantic force for adjustment
has been permitted to occur ever since a human race existed, but
in the short period during which historic records have been made
it is clearly recognizable that wars when continued too long
frustrate the objects of all contending parties. The 30 years war
for example would have brought more terrible results to all
European nations concerned, if it could have ended
by the 3 or 4th year after it began. I am not speaking
of wars that ended in complete extermination of one or
other nation - as for the Crimean war - but of such
all contributing factors as being impossible - in such a
care the only way he reached by compromise and
compromise is a means of diplomacy out of the military
may just end as a diplomatic genius such as England
has produced so many - to be led by humaneness as
a warm and heart.

BALTIMORE,

January 11 1917

ALBRECHT VON HALLER:
SCIENTIFIC, LITERARY, AND POETICAL
ACTIVITY.

By JOHN C. HEMMETER, M. D., PH. D.

Albrecht von Haller was born October 18, 1708, at Bern, [65] Switzerland. He was the fourth and youngest son of the attorney-at-law, Nicholas Emanuel von Haller. According to his own biography and the statements of his most reliable biographers, Ludwig Hirtzel and Jacob Baechtold,¹ he was possessed of extraordinary and precocious powers of observation, versatility in language, poetic talent, and unusual industry in collecting facts and objects. He is said to have been a very weakly, timid, and always serious child, and was taught by an old pedantic theologian, whose curious character aroused the satiric, poetic power of his tantalized pupil.

Haller himself narrates to his oldest biographer that at the age of nine years, he had produced an extensive lexicon of all the Hebrew and Greek words of the Old and New Testament, a Chaldaic grammar, and between one and two thousand biographies of distinguished personages.

However incredible these statements may appear, Ludwig Hirtzel, who, according to my friend, Professor Henry Wood of the Germanic Department of the Johns Hopkins University, is an absolutely reliable biographer, gives an authentic poem of Haller's of the year 1721, which is an elegy on the death of Frisching. The poem was written then when Haller was 13 years old, and in its title the poet calls himself a "poet who is a lover of virtue and disciple of wisdom."

¹ Geschichte d. Deutschen Literatur in d. Schweiz, p. 489.

[65] Whilst this poem does not show the perfect rhythm and majestic sentiment of the poems of his later years, it is nevertheless an effort that must be considered genuinely poetic.

In 1722 he left his native city and became a student under the physician John Neuhaus in Biel, who was a worshipper of the doctrines of Cartesius (Descartes), which, however, repelled his brilliant pupil.

At that time Haller was 14 years old, and now we are told of his first morbid inclination. He was continuously sick, avoided playmates, locked himself up for months and consoled himself with poetry in various languages. He wrote a long epic poem on the Origin of the Swiss Union of States, several tragedies, and translated Ovid, Horace, and Virgil. As another evidence of a morbid inclination, the facts may be cited that he once saved this mass of verse and literary compilation from a burning house at great risk, but later on he burnt them up, part and parcel.

In 1723 he went to the University of Tübingen, but was not well impressed with the rushing student life there, nor made much progress in his special studies, and in April, 1725, he [66] went to Holland to study under the renowned Boerhaave at the University of Leyden. A month before his departure, as Haller himself writes, he composed the beautiful hymn "Morning Thoughts." This is an apotheosis on the Omnipotence of the Creator and is undoubtedly one of the most impressive poems in the German language. A few lines to illustrate this poem may be pardoned:

Der Mond verbirget sich, der Nebel grauer Schleier
Deckt Luft und Erde nicht mehr zu;
Der Sterne Glanz erblaszt, der Sonne reges Feuer
Stört alle Wesen aus der Ruh—
Durchs rote Morgentor der heitern Sternenbühne
Naht das verklärte Licht der Welt;
Die falben Wolken glühn von blitzendem Rubine
Und brennend Gold bedeckt das Feld.

And then our poet, addressing the Creator of Nature, continues:

Du hast der Berge Stoff aus Thon und Staub gedrehet
Der Schachten Erz aus Sand geschmelzt;
Du hast das Firmament an seinen Ort erhöht,
Der Wolken Kleid darum gewälzt.

At that time Boerhaave was in the fullness of his power. [66] The maturity of his broad experience undoubtedly laid the foundation of all the future works of Haller, but here Haller met two other men of scientific greatness; the younger Albinus, Frederick Bernard Albinus, a skillful and sagacious anatomist, who in 1745 became Professor of Anatomy; and also Ruysch, who was his teacher at 90 years of age. He took his degree of Doctor of Medicine in 1727 at Leyden on the basis of a thesis in which he exposed the error of Professor Coschwitz of Halle, who had maintained that he had discovered a new salivary duct of the submaxillary and sublingual glands, which Haller proved to be a vein. Thereafter he traveled extensively in England, visited Belgium and Paris in 1728, and studied mathematics in Basel with Bernoulli. In 1730 he returned to Bern and there practiced medicine and continued his researches in anatomy and physiology, spending his leisure hours in noting down poetic inspirations and making botanical explorations. In 1736 his fame had spread to such an extent that George II of England, who was also Elector of Hanover and Braunschweig, offered him a chair of anatomy, botany, and medicine at the newly-founded University of Göttingen. Haller accepted, and labored in Göttingen for 17 years, carrying out his most important inquiries and compiling most of his literary work. He founded the anatomical museum and laboratory, the botanical school and garden, and the obstetrical department at Göttingen. He was one of the founders of the scientific association and editor of its commentaries. Later on, he refused several calls to other universities, noteworthy among which was one by Frederick the Great, to a chair at the University of Berlin.

He returned to Bern in 1753, prompted partly by illness and partly by ambition for official station in his Fatherland. In Switzerland he passed the last 24 years of his life, taking his share of municipal and state duties. He eventually was elected a member of the great National Council of Switzerland.

Towards the last years of his life, persistent severe pain led him to the continuous use of opium. He passed quietly away on December 12, 1777. In the last moments of his life he

[66] had his fingers on his own pulse and said to his friend, who was standing at his bedside, "The artery no longer beats."

Haller was married three times. His most extraordinary versatility as a poet, litterateur, political economist, botanist, physiologist, physician and surgeon, has been the wonder of his many biographers.

He applied his tremendous intellect to the solution of many questions throughout physiology, and in the preface of the sixth volume of his *Elementa*, he gives a list of what he claims as some of his own discoveries. There is no doubt whatever that he correctly recognized the mechanism of respiration, and his researches on the "formation of bone" and the "development of the embryo" are of the highest importance.

HIS LITERARY AND POETICAL ACTIVITY.

In the year 1728, Haller, in company with a friend, traveled through his native country, which up to that time had been to him an unknown territory. The real object of this trip was not so much to observe the works of man as to get into communion with Mother Nature. In accordance with this plan he made a collection of rare specimens of the Swiss flora, and in fact everything, whether of high or low degree, became the object of his undivided admiration. Never did the uplifting thought leave him that God indeed had made everything beautiful, and devoted to some purpose in nature's economy. The glacier and the gentian, the tumbling brook and the dew drop, one and all, united our enthusiastic teleologist to God's service in His boundless temple of Nature.

The impressions made upon him were put into poetic form in the following year in a poem entitled "Die Alpen" (The Alps). Haller compared with biting sarcasm the low morality of his native town, Bern, with that of the old Swiss type, and thus emphasized his sympathy with Muralt's staid reformatory tendencies, revealed in the latter's "Letters about Englishmen, Frenchmen, and about my Journeys." He advises sufferers from the low morality of large cities not to seek recovery by going to Paris, but by travel to Switzerland where liberty and sincere morality prevail. Haller, the sentimental

precursor of Rousseau, calls the people of Switzerland happy [66] because of their ignorance about those evils which are the usual concomitants of growing cities. In his poem, in which he gives evidence of all that manly strength of which he is capable, and in which moreover he displays intense longing for pastoral quietude, he described the inhabitants of the Alps, not as peaceful Arcadian shepherds of the well-known stage type but as children of Nature, honest, unsophisticated people of the good old time. He praises their high ideals of matrimony, their harmless, good-natured festivities, their brawn, their various occupations as called for by the changing seasons, and brings all these things to the notice of the dwellers in cities. He pictures to us a beautiful landscape, surrounded by the Alps, which serve as a natural defence against the evil influence of the outer world. Winter ap- [67] proaches and you enter the hut high up in the mountains. Three generations gather around the fire-place—a young poet of nature sings his simple melodies, three older members follow him in turn, one speaking of the wonders of nature, and the others relating stories of heroism in the battles for independence, and praises:

Tell who removed with intrepid courage the yoke which is still borne by half of Europe.

Thus from the Swiss mountains resounds first the battle cry "In tyrannos," which Schiller, Haller's successor in many respects, so frequently used, Goethe having previously made use of a democratic motto from Haller for his "Goetz von Berlichingen." Liberty and decent moderation are the unflinching precepts in a poem which forms the sentimental and purposeful supplement to his "Vitiating Morals," and the satire "The Man after the World." The young citizen of Bern thus described his countrymen:

No, surely 'twas not so before France got to know us,
Unknown to us were then the very names of crime;
Harmful extravagance our poverty withheld.
Sin in its wake was foiled by gentle singleness.
We had one fatherland, one God, and one free heart;
But now, alas — we fall!
The courage of our citizens which sanctified a state

[67] The marrow of our fatherland grows old and dies away,
And once again in history the world will surely read:
How states must go to ruin when moral law they will not heed.

Later on he renounced his praise of these Alpine children of nature, for it subsequently became evident that the youthful traveler had transported himself in his poetic fervor to a beautifully conceived past, or to a place that existed merely in his fancy when he said that the shepherds prefer the sparkling water from the mountain spring to the golden wine, or the son of nature despises the gold sand in his rivers: "The shepherd sees this treasure, he merely looks at it and lets it float away." This sentimental bias and pessimistic view of civilized life was supplemented, however, by a very practical common sense view of nature on the one hand, and on the other by an exuberant optimism of a religious character. Haller believed, like Leibnitz and Pope, "Everything which exists is good and for the benefit of humanity." Thus the Alps furnish us in their vegetation with medicinal herbs, the mountains with crystals and curative springs, and the icy glaciers even are there for a purpose, in that they irrigate the surrounding country. In brief, the Creator has done everything for the best of humanity. But such doctrine made it incumbent upon him as a faithful follower of Leibnitz to work out a so-called theodicy, an explanation of God's indulgence in permitting the existence of evil at all. He good naturedly pacifies us with the assurance that God's divine kindness will work out everything for the best, whereby humanity, "the pitiable, intermediate type between angel and beast," does not become the wiser.

During the first half of the eighteenth century one fanciful theodicy followed another. The fearful earthquake of Lisbon in 1755 gave the optimists a severe blow. Voltaire, Haller's opponent, in a poem devoted to this awful catastrophe, referred to the latter as a terrible argument against the above-stated doctrine. Voltaire himself, had deduced the existence of God from the established order of creation, without resorting to such ridiculously trivial teleology as to praise the creator of the cork-tree as the furnisher of the highly useful stopper. His often quoted saying, "If there were no God he

would have to be invented, but all creation proclaims his [67] existence," should be treated with as much consideration as Haller's maxim—"Enough! There is a God, for nature doth proclaim it." But now the best sections of a flourishing city go to ruin, and in the deliciously satirical tale, "Candide," this pious hallucination is mercilessly scourged. Haller, who took pleasure in displaying his antagonism to Voltaire, had by that time already given up his poetic activity. One small volume of poems represents about the extent of it. It is this feature, in conjunction with an unusual intensity of thought, which gave to his "Swiss Poems" an epoch-making value. By way of contrast to a whole cluster of poetasters of the "quantity not quality" variety, a serious philosophic poet had made his appearance. These made rhymes after rhymes in quick succession; but he, conscientious about the wording of his verses and the creation of new forms wherever he felt the need of such, was content to complete about ten verses an evening. The former showered fulsome, insipid eulogies on their friends and patrons, but he pointed out the line of demarcation which separated his Nuptial Song to a Swiss Cato² from the usual cheap congratulatory poems. On the one side chaff, on the other side grain, although of a small quantity; on the one side dazzling raiment, on the other a heavy suit of armor; there prodigality, here economy, almost penury; there superficial amusement, here high ideals pertaining to life and its problems.

Haller was the first to impart force and depth to German poetry, even if he did not assist in bringing about facility of expression. One should read his truly great fragment "About Eternity," in which he portrays a desolate landscape, crags, sinister trees, a bird that has lost its way, and an idly-flowing brook—a spot where the lonely pilgrim directs his attention to the contemplation of eternity and is overwhelmed by the thought of a beginning without an end. But

² Note by J. C. H.—M. Porcius Cato, the elder, was noted as a rigid judge of morals, and this Swiss Cato must have been of the same character.

[67] how can he, who is subject to finite conditions, comprehend the infinite:

On awful numbers I place numbers,
And millions of mountains I heap;
I roll cycles upon cycles and worlds upon worlds;
And when from this tremendous height
With trembling fervor I again thee seek,
O God! All might of numbers
Increased a thousandfold
Is not yet a part of Thee!

Kant cites these lines of "the most sublime German poet" in his essay on the "Infinite in Creation." To regard life from [68] a pleasant point of view, to sing the songs of youthful gaiety, was foreign to Haller's ponderous nature. Inclined to loneliness, reserved and sensitive, lacking resiliency to experiences of a disagreeable character he kept aloof as he himself stated from a real understanding of the joy of youth. Love was to him the most serious occupation to which he devoted himself. Although penurious in his lyric effusions relating to it, he however created in his "Doris" the ideal of womanhood; his deeply-conceived elegies on the occasion of the death of his first wife and also on that of his second were evidences of his intense feeling. With this tearful offering Haller bid the world of poetry farewell.

As a Göttingen professor, soon afterwards Albrecht von Haller became famous throughout Europe as the "Great Haller." The Academy of Berlin sought him, but the free-thinking tendencies of Frederick's court were distasteful to the pious Christian. Possessed of immense learning, he devoted himself with indefatigable industry to scientific study. Histories of botany, physiology, and anatomy must each give him his due share of honor. An examination of the mural decorations of the exterior of the University of Vienna reveals his name as combining in one person the rarest abilities of the investigator and experimenter in the domain of natural science with an almost unattainable knowledge of literature, and withal pervaded by an unusual sense of modesty. He was a veritable encyclopedia of information, "*πολυμαθής*," wrote for many years reviews on books relating to all departments of knowledge, at one time appeared in the rôle of a theologian,

at another as a politician, and in his last period became a [68] statesman and administrator of public affairs. He rehabilitated the poetic and scientific fame of Switzerland. The very fact that a scholar of his type should not disdain to write a volume of poems, exalted poetry and the poet in the estimation of the people.

CONTRIBUTIONS TO ANATOMY AND SURGERY.

Albrecht von Haller must be mentioned as one of the first to investigate the etiology of septicæmia. He made the experiment of injecting putrescent substances into the veins of living animals, establishing the fact that they were rapidly killed thereby.³

In another direction he stimulated pure surgical research—namely, in an investigation concerning the development of a collateral circulation after the ligation of larger vessels—the larger anastomoses had in fact been made out by Haller.⁴ Concerning echinococcus of the liver, Haller held the view that it was an exuberant formation of follicles.⁵

The founder of the surgery of the diseased states of the biliary passages was J. L. Petit, who recommended puncture of the gall-bladder for advanced stagnation of bile, and the removal of gall-stones by incision; but to make both operations feasible, he postulated the necessity of adhesion of gall-bladder with the abdominal wall. The first to support the views of Petit were Haller and Morgagni.⁶

Haller described exactly the invagination of the colon into the rectum and gave its differential diagnosis from rectal prolapse.⁷ In writing the history of hernia as a pathological entity, it should never be forgotten that Haller clearly described the peritoneal process extending into the scrotum as the persistence of a foetal physiological formation; opposing the view of Reneaulme, then prevalent (since 1721) that it

³ Friedrich Helfreich. *Geschichte d. Chirurgie*. In Neuburger's and Pagel's *Handbuch d. Gesch. d. Med.*, iii, 20.

⁴ Loc. cit., p. 86.

⁵ Loc. cit., p. 219.

⁶ Loc. cit., p. 222.

⁷ Loc. cit., p. 239.

[68] was an abnormal place for peritoneum, for he and J. Hunter demonstrated the protrusion of the peritoneum that preceded the descent of the testicle, and argued that in congenital scrotal hernia the intestinal loops must of necessity follow the same channel. Haller correctly described a large hydro-nephrosis discovered by him at autopsy.*

His principal achievements in anatomy were: 1, a demonstration that the salivary duct discovered in 1724 by Cosch-witz, was a vein; 2, an investigation of the respiratory muscles and an exhaustive description of the diaphragm, with an interpretation of the intercostal muscles as elevators of the ribs; 3, a demonstration of the uterine musculature; 4, a demonstration of the coni vasculosi, *Vasculum aberrans Halleri*; 5, a correct description of the musculature of the heart and an accurate description of the pericardium and of the valves in the veins; 6, a description of a number of unknown or, at least imperfectly known arteries (*Tripus Halleri*, triple branching of the celiac artery, description of the course of the musculophrenic and of the internal mammary artery, anastomoses of the internal mammary with the intercostal artery); 7, the higher location above the pubes of the bladder in children; 8, a description of the omentum; 9, a demonstration of the *Tela cellulosa* as a connective tissue substance.

His successors in Göttingen were Johann George Roederer, 1726 to 1763; Johann Gottfried Zinn, 1727 to 1759, and Heinrich August Wrisberg. Zinn and Wrisberg, two undoubtedly brilliant anatomists, were direct pupils of Haller. Zinn has become immortal through his classical description of the eye and its surrounding *Zonula of Zinn* (ligament of Zinn). This illustrious pupil of Haller became professor of medicine and director of the botanical gardens in Göttingen, 1753 to 1759.

The Swiss clinician, John George Zimmermann, was also a pupil of Haller. Both Zinn and Zimmermann assisted him in his investigations concerning the brain. Among the successors at Göttingen was Samuel Thomas Soemmering, 1755

* Loc. cit., p. 276.

to 1830, whose comprehensive text-book is a monument in the [68] history of German anatomy. Soemmering was undoubtedly the most talented German anatomist at the beginning of the nineteenth century. Among the other intellectual descendants of Haller are Johann Friedrich Blumenbach, the founder of modern anthropology, and Johann Friedrich Meckel. Thus Haller's influence extended to the entire anatomical world of [69] his period.

Concerning the functions of the Eustachian tubes, however, he did not recognize the full truth, for he believed them to serve the conduction of sound and not as Schellhammer experimentally proved in 1716 for ventilation of the tympanum.

Exact medical historic research must credit Haller with a valuable discovery concerning the anatomy of the eye, for he was the first to describe the "lamina cribrosa" at the entrance of the optic nerve into the eye-ball (see Comment in Boerhaavii praelectis Götting. 1749), and he also, as well as Zinn, made clear the structure of the choroideal tract in the eye,⁹ but he again failed to grasp the actual fact when he denied the existence of muscle fibers in the ciliary body and that they could influence the size of the pupil. But in this error he had investigators no less noted than Morgagni, Zinn, and Fontana as companions. Whilst he paved the way for a correct physiology of vision by his doctrine of the irritability of nerves, he seems to have failed in grasping what was known of refraction. As I understand Haller (*Elementa Physiologica*, Lib. XVI) he regarded light as a form of matter and ascribed to it a remarkable degree of substantiality.¹⁰ Although he attributed refraction erroneously to contraction and dilatation of the pupil, his conception of the projection of the visible object on the retina was correct. It was a valuable service to the physiology of vision to emphasize the retina as the organ for light perception and not the choroid as Mariotte had argued previously.

Haller's analytical thinking and patient observation gave much new information in regard to neurological and mental

⁹ C. Horstmann. *Geschichte d. Augenheilkunde*, pp. 496 and 497.

¹⁰ Vide supra, p. 499.

[69] diseases that eventually led to searching inquiries. In his *Elementa Physiologica*¹¹ he not only compiled that which was of interest up to that date, but added his own rich experiences and observations at autopsies. He emphasized that the brain was abnormal in all diseases of the mind and that the pathological alterations frequently extended to the cord and nerves, and he asserted that if nothing abnormal could be detected in these parts in rare cases, it should not be concluded that they were normal, but he preferred to think that the disease process was located in the "finest organizations" of these parts or that perhaps the examination had not been exact or careful.

The history of the development of gynecology would not be complete without including his anatomical, physiological, and pathological contributions, which are embodied in part of the 28th book of the *Elementa Physiologica*.¹²

CONTRIBUTION TO THE PHYSIOLOGY OF CIRCULATION AND RESPIRATION.

One of the most definite facts of this greatest of modern medical encyclopedists, and a fact upon which all later anatomists and physiologists agree, is that by his exhaustive work in anatomy and physiology references to literary sources earlier than his time have not only been greatly facilitated but in great part have been made superfluous; *i. e.*, one need as a rule only refer to his writings to learn the views of his predecessors on any important fact in these subjects.

In his preface to his *Elementa* he opposes the separation of anatomy and physiology—for him they were inseparable and yet he himself was the first to make physiology independent by his objective way of thinking and the significance he gave to experiments on the living animal. Sir Michael Foster correctly says:¹³ "When we turn from any writers of physiology preceding his time and open the pages of Haller's '*Elementa*,' we feel that we have passed into modern times."

¹¹ Lib. XVII, Sect. I, par. 17, Tom. V, Lausanne, 1763.

¹² Bernae, 1765; *Mulierbia*: Sectio II, *Uteri fabrica*.

¹³ Lectures on the History of Physiology, p. 207.

Microscopic work with higher powers was quite unknown to [69] Haller, but all that could be observed by anatomical investigation simply,—even general histology,—whatever could be elicited by simple vivisection with the application of the means of stimulation known in those days—all that could be accomplished by these means are described in his *Elementa* in words that even to-day retain their full meaning; his facts are critically weighed and he cites the complete literature known to him.

The finer anatomical and physiological techniques of to-day were not dreamt of by him, and those processes of living matter that could only be studied by the methods and in the light of the chemistry and physics of those days were necessarily incorrectly or incompletely understood. In a study of the dynamics of the circulation whose foundation was laid by Harvey, Bellini, and Bovelli, or even earlier by Michael Servetus, Matheus Realdus, Columbus, and Cesalpinus,¹⁴ the work and views of Haller are noteworthy. He was the contemporary of the versatile English divine Stephen Hales (1677 to 1761) a man whose mind was replete with original thought. His work on the physiology of plants and on hygiene is exceptionally meritorious, and in his work on "Hemostatics"¹⁵ Hales describes his classical experiment of determining the hydrostatic pressure of the blood by tying a long straight glass tube into the artery of a horse. Singularly enough Haller, though familiar with this pioneer contribution, does not appear to estimate it sufficiently or correctly; in fact he does not cite Hales in his discussion of arterial pressure, although he makes use of his observations in his consideration of means "to determine the force of the ventricular systole," which perhaps was permissible in those days, for soon after more direct methods became available for this study.

Haller discusses exhaustively the determination of circulation time. He denies the so-called self-regulating mechanism of the heart, the coronary circulation, and even disproves

¹⁴ Hemmeter. Johns Hopkins Hospital Bulletin, 1905, XVI, 165.

¹⁵ Statical Essays, Vol. II, 1732.

[69] it. This controversy arose again in the nineteenth century between Hyrtl and Brücke.

[70] In his description of the changes of the form of the heart during contraction and the cardiac impulse, he lays more emphasis on the changes of form than did Harvey. He shows familiarity with the influence of gravity and of the respiratory aspiration of the thorax on the circulation in the veins.

One of his most brilliant experiments as well as arguments is the demonstration of the automatism of the heart. Anatomists, physiologists, naturalists, and medical men in general at the time of Haller were under the ban of the doctrines of George Ernst Stahl (1660-1734), a brilliant metaphysical philosopher, and unfortunately for science of his day, an influential writer and man of exceptional individual force. He assumed that all physical and chemical processes in the living creature, even the very simplest, were fundamentally different from those in the lifeless world, in that they were induced and controlled by a "sensitive soul," the "Anima Sensitiva." This conception is entirely different from that of the "reasonable soul" of Descartes, by which this philosopher meant to differentiate man from animals. Stahl's "Anima" reminds one more of the "*φύσις*" of Hippocrates, or the "Archæus" of Paracelsus and of van Helmont, for it is present in all that is living and disappears from it when death occurs. Stahl was the first "Vitalist" and his "Anima" was inseparable from the central nervous system. It is evident from this definition that an organ that could function when entirely separated from brain and cord was unthinkable to the medical world of Haller's day, when the doctrines of Stahl exerted a kind of tyranny over the opinions of physiologists. Now when the Bernese Aristotle with his then unassailable objective demonstrations and the force of his logic correctly proved the entire independence of the activity of the heart from the central nervous system—not only this, but even more, for he emphasized the irritability of the myocardium itself as the cause of the cardiac rhythmic activity,¹⁶—he dealt a killing blow from which the hypothesis of Stahl could not recover.

¹⁶ *Elementa*, Vol. I, p. 488.

As said before, Haller must be credited with the first correct and complete presentation of the mechanism of respiration, for there were other prominent anatomists, Hamberger (1697-1755) for one, who held that the lung contracted by its own inherent power, like a muscle, and that the pleural space between the lung and thoracic wall contained air. Haller succeeded in preparing the costal pleura in a living animal without injuring it in the least, so that the lung could be seen through it. He showed that the lung passively expanded, whilst it followed the receding thorax and descending diaphragm. His description of the diaphragm is anatomically perfect.¹⁷

It is regrettable that the chemistry of respiration was a "terra incognita" to him, who like many other thinkers of his time was held perplexed in the dark maze of Stahl's phlogiston theory. He knew of John Mayo's work on Respiration, and even cites it, but he failed to understand what Mayo meant by his "Nitro-Aereal" or "Igneo-Aereal" particles. The appreciative mind of to-day reading Mayo's ideas in the light of later progress by van Helmont, Lavoisier, etc., can understand that Mayo meant that the part of the atmosphere that was essential for burning was essential for all the chemical changes on which life depends and that the "Nitro-Aereal" particles of air are the oxygen of to-day. It is questionable whether any of Haller's contemporaries understood Mayo, or even whether this English apostle of physiology was understood in his own country. I do not think it correct to assert, as Sir Michael Foster does,¹⁸ that Haller rejected the advances of the English school (Boyle, Hook, Lower, and Mayo). He gave them fair consideration; he did not accept them; neither did he clearly reject them. He was an agnostic for the time, as most conservative thinkers should be. One must not overlook the fact that these men expressed themselves largely in terms of their own invention concerning their views of respiratory gases, and that they were unavoidably vague, and were not in entire agreement. After

¹⁷ De diaphragmate. Göttingen, 1791.

¹⁸ Loc. cit., 230.

[70] discussing all views known to him, Haller declines to accept the view that particles of air actually pass into the blood; but immediately thereafter warns the reader that his doubt concerning the theories of the English school "does not or should not lead to the conclusion that in breathing we derive nothing from the air."

Haller induced his disciple Rhodes¹⁹ to write a dissertation on the iron content of the blood (Göttingen, 1753) and he attributed the red color of the blood to the iron.

The physiology of the larynx is excellently presented in his *Elementa*,²⁰ but he appears not to have known the function of the lateral cricoarytenoid muscles in opening the glottis.

CONTRIBUTION TO THE PHYSIOLOGY OF DIGESTION.

To the modern student of Haller's physiology it soon becomes apparent that the weakest points of Haller's work are where he comes in contact with purely chemical phenomena in the explanations of the processes of life, and this is not surprising, since the chemistry of today was practically unknown. It was not until after Haller's death that Scheele, contemporaneously with Priestley, discovered oxygen in 1786. I have already referred to the retarding effect of Stahl's phlogiston hypothesis, which impeded the development of chemistry fully as much as the delusion that the septum of the heart is perforated did retard the development of the physiology of the circulation of the blood.²¹ Even Scheele was an ardent adherent of the phlogiston theory. It is quite pardonable, therefore, that Haller, who had no special training in chemistry and had not even been an apothecary, like some of the clinicians and chemists of his time, should have no comprehensive knowledge of the chemical progress taking [71] place during his life and which was giving birth to a new chemistry under the stimulus of Black, Mayo, and Priestley in England and Lavoisier in France.

This same defect in interpretation we find in Haller's pre-

¹⁹ Boretan, *Gesch. d. Physiol.* (Julius Pagel writes this name Rhades) in Part I of Neuburger's and Pagel's *Gesch. d. Med.*

²⁰ Vol. III, p. 366.

²¹ Hemmeter. *Johns Hopkins Hospital Bulletin*, 1905, XVI, 165.

sentation of the functions of the digestive organs, where we find many erroneous conceptions; but his description of digestion is distinctly in advance of the time. The activity of the salivary glands as dependent upon nerve influence (irritation by smell or taste) is an idea that does not appeal to him, although he concedes a certain degree of irritability to the salivary glands. To him the saliva is neither alkaline nor acid, and he interprets its function to be merely a mechanical one to aid in the formation of the bolus and facilitate swallowing. He does not know its starch-digesting property, for ptyalin was not discovered until 1831 by Leuchs.

The glands of the stomach furnish only mucus according to Haller. The gastric juice is a kind of transudate from the arteries; it is neither alkaline nor acid, but neutral. Acid is not present in the stomach normally; if present at all it is derived from abnormal decompositions of the gastric contents. In the sixth volume of his *Elementa*, page 57, he looks with disfavor on the use of the word "ferment," to explain the action of the gastric juice, which is, according to him, much assisted by the grinding and mechanical effects of the movements of the stomach.

The various functions of the pancreas are not known to him. Though he speaks of neutralization (*Milderung*) as being one of them, he does not mean neutralization of the gastric juice but of the bile.

The bile he considers to be an especially effective secretion for digesting the fats, which he declares are immediately emulsified by it. It is according to him not an excretion but a secretion and this he attempts to demonstrate by the effects of excluding bile from the intestinal canal. It was still thought by many physiologists that bile was produced in the gall-bladder, but he was an opponent of this belief, as he knew that bile is produced in animals who have no gall-bladder. In this connection he emphasized the importance of comparative physiology. In connection with his doctrines concerning digestion, his discussion of the foods and diet of human beings are very interesting, but naturally imperfect in the light of our present knowledge.²²

²² *Elementa*, Vol. VI, pp. 188, 258.

- [71] His description of the structure and the gross functions of the kidneys is admirable, but the chapter on the urine (this being again a chemical subject) is in accordance with the deficient knowledge of those days.

CONTRIBUTIONS, VIEWS, AND EXPERIMENTS CONCERNING THE
CENTRAL NERVOUS SYSTEM.

Haller's work on the brain and spinal cord will be better understood after his doctrine of irritability has been studied. In testing the irritability of the brain and its membranes he frequently went too far, because of the incompleteness of his methods and crudeness of his instruments. A part of his first brain studies were upon the cerebral pulsations. In 1750 the Dutch physician Schlichting had shown that the pulsatory movements of the brain were caused by the activity of the heart and the respiratory movements, but at the same time had been led to assume a kind of independent brain movement. The question was taken up by the Paris professor Lorry, 1725-1786, who disproved the theory of an independent movement of the brain, but at the same time held that the brain pulsations were pathological. Haller²³ attributed the brain pulsations to venous stagnation. In his experiments on the gray cortex of the brain, he was assisted by his pupils Zinn and Zimmermann. The physiological techniques of these experiments were very faulty viewed from our present standpoint. They made use of needles and sticks of wood saturated in acid, which were stuck into the gray matter. It is not surprising that they always obtained the same results, namely collapse of the animals, and convulsions—the well-known epileptic attacks when the cortex is stimulated too powerfully. He considered the gray cortex as devoid of sensibility and attributes positive sensibility only to the white medullary substance. Thus he is opposed to ideas of localization, the beginnings of which had already been made by other physiologists. He recognized that the cerebellum, by carefully conducted experiments, could not be proven to be an organ that is essential to life,—that is, not more so than the

²³ *Elementa*, Vol. IV.

cerebrum; but he conceded the great importance of the [71] medulla as a portion of the brain that was immediately essential to life. This concession was, however, forced from him by his brilliant pupil Zinn. Lorry had shown that the only locality in the whole central nervous system through which convulsions could be caused invariably—that is of course after clean and careful experimentation—was situated in the medulla oblongata. Isolated injury of this spot could cause death, according to Lorry, and Haller recognized this also. Another epoch-making discovery he confirmed without reservation: the discovery of the contralateral innervation, by the French physician, Pourfour du Petit (1664-1741). This brilliant observer accurately described the crossed paralysis which occurred in trephined animals whose cortex had been injured on one side, and then demonstrated the decussation of the pyramids. There had been some intimation that such a crossing of the motor fibers probably existed, for the ancients had already described autopsy findings in persons who had died of apoplexy which foreshadowed the great physiological discovery of Pourfour du Petit.

THE NEW CONCEPTION OF IRRITABILITY AS FIRST PRESENTED
BY HALLER.

In presenting this new aspect of living matter as first conceived by Haller it will be necessary to review the opinions held on this same subject by physiologists prior to him. Sir Michael Foster says "And to call attention to the general view of Glisson's because this was the mother idea which led him to a special conception of the properties of muscular tissue, through which he anticipated modern teaching by nearly a hundred years. In his work on the liver, in discussing how [72] it comes about that the bile is discharged into the intestines at certain times only, namely, when it is wanted, he shows that the gall-bladder and biliary duct bring about a greater excretion when they are "irritated." And he argues that they cannot be irritated unless they possess the power of being irritated. This power of being irritated he proposes to denote by the term *irritability*. And he develops this view again in his work on the Stomach (De Ventriculo), published

[72] the year of his death, though wholly written as early as 1662, but laid aside in order that he might devote himself to his work "*De Natura*."

"Thus it is undoubtedly to Glisson that we owe the first introduction not only of the word but of the idea of irritability, which, revived by Haller, as we shall immediately see, in the next century became firmly established in physiology and has played an important part in the development both of physiological and pathological views. Haller used the word in its narrower sense as the property through which muscle responds by movement to an external stimulus; since then it has been extended to mean response in any way, not by movement or change of form only but by kind of change, chemical change, change of growth, and the like. And it is worthy of note that Glisson from the very first used the word in its widest sense, distinguishing the various ways in which irritability may be manifested and the various agents by which it may be called forth."

It was perhaps by reason of the fundamental and highly philosophical character of Glisson's conception that it did not meet with immediate recognition. The idea had to be put forth in the narrower form, which Haller gave it, in order to be understood by physiologists; but to continue to use a comparison of Sir Michael Foster's: "Glisson's irritability and his notable experiment were like Mayo's igneo-aereal spirit forgotten as the seventeenth century passed into the eighteenth. We have to wait until the latter century, when the truth was brought to light again by the sagacious Haller in his views of nervous action and its relation to muscular contraction."

From this narrative it is evident how the merits of an older investigator may be overlooked in the future development of a new discovery. Glisson was undoubtedly correct in the broader conception and application of the term irritability. Haller's inseparable connection with this discovery is, however, justified through the large number of objective demonstrations and experiments by which he succeeded in proving this new quality of living matter. To us of the twentieth century it might occasionally seem as if irritability had from time immemorial been one of the primordial

conceptions of natural philosophers; and yet this property [72] which at the present day appears as one of the most natural attributes of living matter was not even dreamt of before the days of Glisson nor understood before the days of Haller. The introduction of the idea into physiology constituted as great an innovation and brought about as many reforms and advances in physiology as did the conception and development of the new physical chemistry of our present day.

The most correct course to pursue in speaking of Haller's views concerning irritability will be to quote his own words in his *Elementa*: "There is widely present not only in the animal, but also in the vegetable kingdom, a contractile force by which the elements are brought nearer to each other. This not only seems to be the cause of cohesion in general, but is rendered manifest by the fact that a fiber drawn out lengthways when let go very soon returns to its previous length." This is more properly the elastic force. Besides this there is a contractile force by which the tissues dead or alive shrink when treated in various ways, when for instance they are heated. A contractile force of such a kind is present in almost all animal tissue, unless it be very soft and pulpy ones like brain, or very hard ones like bones and teeth. But there is in addition a special contractile force proper to muscles alone. "In a living animal or one only just dead there very frequently appears spontaneously in muscular tissue a swift contractile movement by which the ends of the muscle are alternately brought nearer to the middle belly and then again recede from it. And even when this contractile movement does not spontaneously appear, it may be excited if a stimulus, such as pricking, or pinching, or some chemical substance is applied."

"Many writers consider this living contractile force as identical with the dead one just described as belonging more or less to all tissues." This view Haller discusses and concludes, "That muscular fiber is the only one which is moved spontaneously in the living animal, or is brought by irritants from rest to movement," and that "the living contractile force must be held to be distinct from the dead contractile

[72] force, since the two agree neither in the laws which govern them, nor in their duration, nor in their seat."

This force he calls *Vis Insita*, the Inherent Force, and the tissues possessing it he calls after Glisson "irritable."

He then discusses whether this property of irritability is identical with that of feeling, and concludes that it is not. "There are many parts which feel, but which are not irritable, and in particular, a nerve, which is above everything sensitive, and yet possesses no contractile force except that common one found, as stated above, even in dead things.

"Wherefore this force since it is different from mere elasticity and from that dead contraction which is common to all fibers, seems to constitute a peculiar property, proper to the muscular fiber, and indeed to mark the character of that fiber, so that every muscular fiber is irritable, and on the other hand you may fairly call muscular fiber everything that is irritable. It is, however, a force of its own kind, different from every other power, and to be classed among the sources of production of motion, the ultimate cause of which is unknown. This same force is inherent in the fiber itself and not brought to it from without.

"I (by my experiments published first in 1739, and again in 1743) separated this irritable nature on the one hand from a mere dead force, and on the other from the nervous force and from the power of the soul. I shewed that the movement of the heart and the irritable nature of the intestines [73] depended on it alone. I confined it entirely to the muscular fiber, in which point the Batavian school does not agree with me, but they will I hope do so when they are willing to distinguish the contractile force common to all animal fiber from the irritable force proper to muscle alone. I also shewed that that force was something perpetually living, and that it often broke out into movement though no external stimulus such as could be recognized by us was acting. By a stimulus, however, it could at any time be called back from rest into action. In a movement produced through it I distinguished between the stimulus, which might be very slight, and the movement called forth by the stimulus, which might be very powerful."

"Some," says he, "have wished to call this force the vital [73] force, but this does not quite please me, since the force may for some little time survive the life of the body. Hence I prefer to call it the force inherent in or proper to muscle."

Further on he says: "Besides this force inherent in muscular fiber, another force is exercised in it, so far like the former that it alone has its seat in muscular fiber. But it is different from the inherent force inasmuch as it comes from without and is carried to the muscles from the brain by the nerves, it is the power by which muscles are called into action." This he calls the *Vis Nervosa*. "It too may survive the death of the body, and in cold-blooded animals is of the same constancy as the inherent force; so that in such an animal recently killed, in which no sensation or voluntary movement remains, a muscle, provided it be moist and whole, is thrown into convulsions when its nerve is irritated. And the same is true of warm-blooded animals." Haller reached these conclusions by countless experiments upon the animals, the results of which he reported to the Göttingen Scientific Society, under the title of "*De partibus corporis sentientibus et irritabilibus*."

In his *Elementa*, Vol. IV, page 532, he described exhaustively all older theories of muscle contraction and emphasizes that the nerve has no inherent contractility of its own, nor can it move actively in any way, as had been asserted before his time. He reports concerning all former conceptions of the nature of nerve function and declines to believe the electrical hypotheses that arose for the first time in those days, and appears more willing to accept a theory explaining nerve function by the flowing of an actual nerve spirit, not in a gelatinous substance as Borelli thought, but in actual tubes.

In observing the expressions of pain and the movements of defense in the animal during his experiments on irritability, he finds that the sensibility of the various organs depends upon their wealth of nerves. The muscles also possess sensibility, side by side with irritability. The tendons and joints, according to him, do not possess sensibility to a marked degree and the peritoneum very little sensibility. The incompleteness of his physiological technic brought it about that he

[73] frequently went too far, particularly with his experiments in stimulating the dura mater and pia mater, as well as the cerebral cortex.

A CHARACTER STUDY OF HALLER.

To discern the intellectual peculiarity and the inner character of all human beings that have achieved greatness is always a difficult problem. One of the principal features in our philosopher and naturalist is his astonishing pleasure in detail and the second most prominent trait is his unusual joy and power of observation. Biographers frequently speak of the secret of the individuality, and correctly so. It is a secret, but not because individuality is the work of forces which are more subtle and puzzling than other forces. The riddle consists in the abundance and complication of the many coacting forces into which we can very rarely gain exhaustive insight. According to Theodor Gompertz (*Griechische Denker*) we might distinguish two fundamental types of world sages. In one there is a preponderance of thirst for fullness of knowledge and an insatiable reception of ever new and manifold material of insight. In the second, the most prominent feature is the striving toward inner freedom from contradiction, toward unconditional mental consequentialness and consistency. Insatiable thirst for knowledge on the one hand, and the desire to have a mind free from contradictions, a so-called logical and orderly mind on the other hand, are not necessarily diametrically opposed to each other. The two represent evidently only differences of degree, but the difference is for that reason none the less real. For a critical study of the state of the inner mind of great human beings reveals the surprising fact that these two qualities are rarely present in one and the same individual. Thinkers like Descartes or Spinoza, who erect a homogeneous and uniform thought structure, stone for stone, idea upon idea, and two detail workers like Aristotle and Leibnitz, who are ceaselessly engaged in special investigations of every kind, represent two deviating varieties of a common genus; for the sake of argument we may designate those engaged in restless detail work, the encyclopedists. This human mind may try ever so hard in seeking strict limitation and definiteness of his thought struc-

ture, for clearness in the inner arrangement of his mind, yet [73] he will never be as successful as an equally versatile intellect that is not animated by so strong a desire for fullness of knowledge, and hence not equally distracted. Insatiable thirst for knowledge in the encyclopedist must, however, eventually bring about a tendency toward clearing up of his thoughts. Such a man will serve the requirements for the arrangement and the systematization of an enormous mass of knowledge. The encyclopedist will mediate upon and invent artifices and tricks controlling the material of thought. An example of this we have in the language of concepts of Leibnitz; or the encyclopedist will become a classifier and systematizer, and as a matter of fact we find that all great human beings with a comprehensive grasp of knowledge tend toward this achievement. Classification and systematization were the great intellectual feats of Aristotle and Humboldt. But strangely enough the best biographers of both of these do not concede that they accomplished research work of enduring excellence. Aristotle was not a research worker in the modern sense of the word; his interpretation of actual [74] facts is often wilful and controlled by preconceived opinions. His interpretations show the inexhaustible resources of a head rich in inventive power, rather than the severe training of a mind that conquers its intuition and bows under the hard yoke of facts.

In Haller, however, we find for once a human intellect eminently fitted to serve classification and systematization; he has an orderly, logical, or consequential mind, and an insatiable thirst for fullness of knowledge, but it is conceded by the most capable judges of the present day that he was a research worker "par excellence."

The life of Haller and his works put to shame the sixteenth aphorism of Heraclitus.

ἡ πολλὴ μαθητὴν νόον ἔχειν οὐκ διδάσκει.

(Too much knowledge does not give understanding or insight.)

His life rather reminds one as fitting to the celebrated aphorism of Hippocrates,

ὁ μὲν βίος βραχὺς ἡ δὲ τέχνη μακρά.

(Life is short, but art is long.)

3

ja

sc

R

P

sc

sc

T

fr

4

(1

Bu

T

(1

r

a

B

t

of

la

w

rg

la

B

li

E

n

[

L

T

M

I

s

l

l

.

c

(19)

3
ja

sc

R

P

sc

sc

T

fr

4
(1

Bu

T
(1

r
a
B

of
la

w
rg

la

B

li
E

n
[

L
T
M

I

s
l
l

.

c

(19)

3
ja

sc

R

P

sc

sc

T

fr

4
(1

Bu

T
(1

r
a
B

o
la

w
rg

la

B

li
E

n
[

L
T
M

I

s
l
l

.

c