ALBRECHT VON HALLER AND HIS 'ELEMENTA PHYSIOLOGIAE' AS THE BEGINNING OF PATHOLOGICAL PHYSIOLOGY*

by

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WE are gathered here this evening to celebrate a special occasion. On 16 October it was exactly 250 years ago that Albrecht Haller was born in Berne, the most powerful state in the old Swiss Confederation. On this anniversary, the name of Haller, the greatest of his countrymen in the eighteenth century, was recalled in deep respect throughout Switzerland—a sign that his memory is still revered among the public at large. But can the same be said as regards his place in the history of science? The late Henry E. Sigerist, another of my fellow-countrymen of whom no doubt you will also have heard, comments in the following words upon a fact that is, alas, only too well known:[1]

> For men of science posterity has indeed only a short memory. No matter how epoch-making their work may have been, the time inevitably comes when it is obsolete and is swallowed up all too soon in oblivion.

I think Sir William Osler accurately summed up the situation with regard to Haller as a scientist when he said that his work had long been judged as an impersonal achievement. Haller was such a versatile scholar that the foundations which he laid have simply been taken for granted by later generations. It never occurred to anyone that there must have been a personality behind these accomplishments of his. For us as medical historians, and particularly for a Swiss representative of this field of study, it is shameful to have to confess that, despite all the commemorations held earlier in his honour, it is only in recent times that we have at last begun to penetrate into the details of Haller's life-work. It is rather as a young man that Haller appeals to us most intimately as a person of extraordinary charm. Not only have most parts of his travel journal and diaries been handed down to us, but also his magnificent poems—which still have power to move the reader today, today perhaps more than ever—afford an insight into his innermost personality.

May I suggest that we begin by first considering Haller's connections with England; in the second part of my talk I propose to select physiology as one of the aspects of his general medical work. Its connections with his teachings on disorders of the circulation will serve to show how far his biological studies encroached on the realm of pathology. In view of the short time at our disposal, however, it will scarcely be possible to do more than hint at certain aspects.

* Based on an address to the Osler Club of London on 5 November 1958.

I

Let us first take a glance at Haller's youth. One of his biographers says with truth that death was already standing on the threshold of his conscious life. A sickly and rachitic child himself, he lost his mother when he was only a few years old. The fact that he was the youngest child in the family, coupled with the loss of his mother, must undoubtedly have contributed to a feeling of inner loneliness, a feeling which was to remain with him throughout his life. On the other hand, the realization that he had only himself to rely on might well account for the tremendous industry which he displayed from quite an early age. Like so many individuals of delicate constitution, the young orphan—who was soon to lose his father as well—was possessed of a relentless determination to succeed, of an ambition that was occasionally even repellent and under which he himself suffered most of all. By his ninth year Haller had already deeply immersed himself in a succession of ancient languages comprising Latin, Greek, Hebrew, and Chaldean—studies which in those days a boy of average gifts would not have embarked upon until the age of fifteen onwards. His first biographer, J. G. Zimmermann, referring to his hero's early years, asserts with the latter's approval that: 'He wrote accounts of the lives of up to two thousand illustrious people after the manner of Bayle and Moreri, whom he had already read by that time.' Knowing this it seems scarcely surprising that Haller was later to achieve renown as a 'bio-bibliographer', in which capacity—according to Osler himself—he stands out above all his predecessors.

We of today can hardly resist a feeling of gross inadequacy when confronted with such *tours de force* as these. But it would be quite wrong to imagine that the young Haller was a one-sided, narrow-minded bookworm! On the contrary, that he was a gay and by no means unadventurous young fellow is apparent for the first time in his rather hectic experiences as a fifteen-year-old medical student in Tübingen. Later, in Paris, he even had to flee from the police—like Vesalius is said to have done in the same city—because in defiance of the law he had been smuggling corpses into his room for anatomical study. Many of the remarks he makes concerning his teachers and hosts in various towns betray a certain impudence. In fact, there are only two men who escape his pungent criticism: one is his professor at Leyden, Hermann Boerhaave, whom he chose as an outstanding example to follow, describing him as 'praeceptor totius Europae', and whose lectures he published with exhaustive commentaries; the other is the Basle mathematician, Johannes Bernoulli, whom he ranks second only to Newton.[2]

What was Haller's impression of England? Reading his diary, which he wrote up afterwards in Basle, one is often inclined to forget that the brilliantly apposite contemporary portraits which they contain were penned by a nineteen-year-old doctor of medicine. After two years' stay in Holland, our young Swiss student was keen to see the world. His first destination was London. Whatever it was that attracted him to England, it is not likely to have been the fact that in Hanover he had already made the acquaintance of the heir to the British throne, the future George II, for his judgement of the latter is a decidedly scornful one.

A much more probable explanation is that a great deal of what he had learned in Leyden was linked with seventeenth-century English medicine. A typical example is the positively mechanistic doctrine by which Boerhaave sought to account for the mysteries of life and which stems ultimately from Harvey's discovery of the circulation.

But it was not studious interests of this kind with which Haller was primarily concerned. He evidently thoroughly enjoyed the crossing and the journey from Harwich to London. He very much regretted his lack of fluency in English, although despite this he managed to find his way around the metropolis. On 26 July 1727 he writes:

> London, the greatest city in the world. The streets on the outskirts are foul, and many of those in the inner city are not much better; but other streets that are newer, as well as the squares, are better. The public buildings are magnificent and usually built of freestone.

Even in those days the London atmosphere was already smoky, and according to Haller the pedestrian was in constant danger from coaches and horses. Haller found lodgings in one of London's most beautiful streets 'between Charingcross and Haymarket, directly opposite Pallmall'. Incidentally, he draws a charming comparison between 'London with Southwark' and Basle. He was delighted by a trip he made on the Thames, whence the views to be seen were, according to him, splendid.

I will leave it to you to decide whether or not Haller's observations on the everyday life of the Englishman still hold good today. In Hirzel's edition of Haller's diary,[3] we read that:

> The coffee houses afford a pass-time for a large part of England. Many do nothing else in life except convey their fads and fancies from one coffee house to another. Here, thousands of newspapers are read, a great variety being printed daily in London, without counting those from abroad. The thoughtful and crafty English squabble over the news they contain and hold forth on matters of court as freely as if they were in Berne.

Here we see for the first time evidence of Haller's highly developed political sense, his subtle appreciation of social conditions. We are reminded that it is as a champion of liberalism, of freedom to criticize State institutions, that Haller was later to write his famous political novels. Of the three books which he published a few years before his death, the second is entitled *Alfred, König der Angelsachsen* (*Alfred, King of the Anglo-Saxons*) and is devoted to Alfred the Great of England. In the form of conversations with a Gothic king who was a guest of Alfred, the novel deals with the pros and cons—mainly the latter—of absolute monarchy, i.e. of the system of government still in force at the time of Haller's visit to England. The book is an exhaustive plea for the introduction of popular representation, for a monarchy based not only upon the nobility but also upon the people as a whole, such as was in fact later to be achieved by the Reform Bill under William IV.

But let us return again to Haller's youth. Not only did he reveal himself in London as a sound politician—incidentally, like every other good citizen of Berne to this very day—but it is even more evident that he had a genuine

admiration for the high level of scientific attainment in England and for the eminence of her scholars. This is brought out by the remarks he makes in his diary in connection with the purchase of books at 'Jungs'—presumably 'Youngs'—one of 'the leading book-shops in London'. After admiring the clarity and accuracy of the printing, an art in which no other country could compare with England, as well as the magnificence of the binding in yellow leather or morocco, Haller writes as follows in the entry for 31 July:[4]

> In the sciences England appears to be second to none, unless it be in the field of jurisprudence. . . . But in the study of Nature, in brilliant experiments, and in all spheres involving geometry and the nature of living creatures, they excel all previous epochs and all other countries today.

The reasons which the enthusiastic nineteen-year-old visitor from Switzerland advances to account for this state of affairs are as follows: firstly, the country's wealth; secondly, 'the contemplative and ambitious character of its people', who carry out everything they do with the utmost perfection; and, thirdly, 'their respect for learning'. He mentions that the Queen personally conducted her correspondence with Newton, Clarke, and Leibnitz. It must be remembered that Isaac Newton had died only four months previously, and Haller must certainly have heard first-hand accounts of Newton's 'magnificent funeral'. He points out that the extraordinary honour in which this great man of science was held among the whole population indicates that outstanding scholarship is as highly thought of in England as nobility and 'military services' in other countries.

There must be few nineteen-year-old students today who would be capable of such profound and accurate observations on a foreign country as these of Haller. But, then, perhaps after all England was not so foreign to him. All his notes do in fact suggest that he was well acquainted with English literature; indeed, throughout the rapid ascent which marked his subsequent career, Haller was to remain a vast reader. Leaving England, Haller returned to Switzerland via Paris—but not without first paying visits to Oxford, to the nearby palace of Blenheim, and to the splendid Chelsea botanical gardens. Upon his arrival in Basle he was once again on the soil of his native land, and the consciousness of having returned home seems to have inspired him to fresh endeavour. Not only did he plunge into a study of mathematics and into the teaching of anatomy and botany, but he also blossomed forth again as a poet. Writing on this subject in the year 1738, he says:

> After my travels, and especially in Basle, the sickness of poetry overcame me once more. . . . [Friends in Basle encouraged him to make a fresh attempt, and he adds]: Meanwhile, I had come to know the English poets better and had acquired from them a love of thought and a preference for more serious poetry. The philosophical poets, whose greatness I admired, soon supplanted in me the bombast and pomposity typical of German poetry at that time.[5]

This is the third aspect in which England had a decisive influence upon Haller. Thus, England's significance for Haller was equally great in the realm of politics, natural science, philosophy, and poetry. Besides Bacon, Newton,

and subsequently the physiologists, it was Swift, Rochester, Butler, and Addison—with whom Haller became personally acquainted in England—as well as Shaftesbury, Blount, Pope, Hobbes, and Mandeville later in Basle, who stimulated the young poet to deeper contemplation and thereby contributed indirectly to such fine poems of his as that entitled 'Die Alpen' ('The Alps').

II

But we are not concerned here with Haller as a poet, and I mention this aspect of his work merely as another example of the profound influence which English thought and sentiment had on the young physician. As I have already indicated, it was his medical interests which were later to become more and more prominent. In addition to Sir Hans Sloane (1660–1753), the President of the Royal Society at that time and later one of the founders of the British Museum, it was the surgeons and anatomists James Douglas (1675–1742) and William Cheselden (1688–1752) who were responsible for his seeing in London fine specimens of bone preparations and medical illustrations. In Paris, a few weeks later, he had an opportunity of familiarizing himself in particular with the method of topographical anatomy—of which he was later to become such an outstanding master. At the same time, it was also in Paris that he was filled with horror at the chaos reigning in the field of anatomy and acquired a deep respect for those who, despite the many handicaps then involved, practised surgery. This no doubt explains why throughout the whole of his life Haller never performed operations himself.

It is difficult to imagine what would have become of Haller had in 1736 the chancellor of the newly founded University of Göttingen not appointed him Professor of Anatomy, Surgery, and Botany. It might be argued that, had he not received this chair, then he would have taught at some other university. The fact remains, however, that the facilities for research which Göttingen could offer him were available in no other university at that time. The British sovereign had founded Göttingen not merely as a teaching centre, but also for the specific purpose of promoting research. Of the many different fields which Haller studied there simultaneously, let us consider one in particular, namely experimental physiology. Here once again we find in Haller not only a man skilled in matters of method, but also a profound thinker.

Right from the time of the earliest observations concerned with vital processes, muscular movement and pain had attracted the attention of natural scientists in particular. The English physician Francis Glisson (1597–1677)—the author, incidentally, of a brilliant description of rickets—had coined the more than somewhat vague term 'irritabilitas' to describe the muscle's capacity to contract. Haller approached the problem from another angle. In hundreds of experiments which he performed over the space of many months together with the Swiss student J. G. Zimmermann (1728–95), he succeeded in demonstrating that muscle reacts to every kind of stimulus in the same way, i.e. by contracting. To this contractility he applied Glisson's term 'irritabilitas'. An equally large series of experiments carried out on various types of animal made it clear

that the phenomenon of pain, which Haller refers to as sensitivity, is dependent on the presence of nerves. Thus, for the first time, experiments in the biological laboratory had shown that certain functions are related to two precisely defined parts of the body, in other words to specific tissues. This represented the first step towards a universal exploration of the phenomena of life; 'anatomia animata', as Haller called it, was thereby extended far beyond the confines of the theory of the blood circulation. Thanks to his monograph *De partibus corporis humani sensibilibus et irritabilibus* (1752), Haller became the acknowledged creator of a physiology bound to the actual substrate itself.

III

This, however, represented the climax of his work as Professor in Göttingen. Home-sickness and political ambition now induced him at the age of forty-five to return home to Switzerland with his large family. Despite offers received from all sides, including an invitation from none other than Frederick the Great, he preferred to accept the modest post of Town Hall Administrator and Doorkeeper in Berne. His most ardent wish—to be elected either member of the government of Berne or provincial prefect—was never to be fulfilled. But during these years of relative tranquillity, that part of his work progressed which might be termed the literary counterpart to his experimental research, i.e. the first comprehensive manual of anatomy and physiology, entitled *Elementa physiologiae*. Quite unobtrusively he also continued his studies on living animals—at least, as far as this was possible in the modest circumstances of his home. Despite all the preliminary research done by Harvey, Jan de Wale, and many others, Haller had already realized while still at Göttingen that none of the data essential for a more exact understanding of the movement of the blood in the vessels were yet available. He had long been assembling literature on all branches of physiology, having apparently already begun with the commentaries to Boerhaave's lectures twenty-five years previously. Hand in hand with this, he was constantly carrying out observations on the blood-vessels of live animals, including frogs in particular. He opened an artery here, a vein there, ligated various blood-vessels, excised the heart or portions of the peripheral vessels, and noted carefully the results of these interventions on the blood circulation. These experiments led to the first general conceptions of the movement of the blood on which a comprehensive theory of haemodynamics could be based. It is astonishing how, by skilful use of the microscope, Haller managed to see into the most delicate processes taking place within the circulation. From his notes on an experiment performed on 14 September 1751, it appears that, after damaging the mesenteric vein of a frog, he was able to observe details of the process of coagulation with the aid of a Culpeper's microscope; 120 years later the pathologist F. Wilhelm Zahn (1845–1904), working likewise in Berne, was to describe this phenomenon in almost exactly the same words. The process in question was that of thrombosis, in which Haller had clearly noted the formation of the blood vortices, the accumulation of what he refers to as 'invisible fluid' around the wound, and the stages by which the wound closed. If subsequent

research was to yield more accurate knowledge, it was merely because the microscopes used were better constructed than the one Haller employed. These early excursions of Haller into the realm of experimental pathology provided a valuable preliminary to the further development of that vitalistic approach which was so powerfully stimulated by the work of John Hunter (1728–93) in particular on the theory of inflammation.[6] These experiments not only formed the basis of Haller's two treatises on the movement of the blood and the effects of vivisection (*Ueber die Bewegung des Blutes und die Wirkungen des Aderlasses*), but they also constitute the central feature of the first volume of his great manual, to which I have already referred.

The recognition which Haller was earning for himself at this period in official circles in Berne seems also to have had an influence on his academic activities. Having meanwhile become famous throughout Europe, he was consulted more and more frequently in connection with matters of state and was called upon to advise on every possible kind of project, e.g. various salt springs near the Lake of Geneva or the organization of the Academy in Lausanne. This necessitated quite a good deal of travelling, which no doubt made a pleasant change from work in the confines of his study. Moreover, these journeys also provided him with useful ideas as regards plans for his own private life. From letters he wrote to his best friend, Johannes Gessner (1709–90), in Zürich, it may be gathered that the mild climate in the region of Bex and Aigle particularly appealed to him. In accordance with his wish, Haller was in fact later chosen as director of the Aigle salt-works in the spring of 1758, his new residence being at Roche.

Anyone who knows Montreux-Villeneuve, the district around the upper part of the Lake of Geneva, will, I think, agree with me in admiring all the many delights of this glorious countryside. Today, travelling either by train or by car away from the upper end of the Lake of Geneva towards the Canton of Valais, the route takes one past the little village of Roche, backing on to the steep slopes of the hillside and looking just as sleepy and peaceful as it must have done 200 years ago. In the midst of other houses and surrounded by a small park is a building which, though scarcely distinguishable from the others, rejoices in the name of the 'château'. It was in this modest abode that Haller spent six years of his life.[7] It was here that the major part of his *Elementa physiologiae* was written, i.e. volumes 3–6, and here that Haller carried out his difficult embryological experiments on chickens' eggs. The latter, despite the mistaken theories on which they were founded, contributed much that was of real value. Nor should it be forgotten how much this great scholar achieved as an administrator in the course of his official duties. So all-embracing were his interests that he not only contrived to make the salt-works more profitable but also drained a large area of swampland and successfully overcame a cattle epidemic; finally, in the latter years, he even had to deputize for the Governor of Aigle, a task in which he was called upon to attend to complicated political matters. In addition, his letters make frequent reference to visits paid him during this period; his exchanges with Voltaire also took place at this time.

But we must now revert once more to his great work of scholarship. During the first year of his residence at Roche, his publishers in Lausanne printed the second volume of his manual. In this volume, which deals with the blood circulation in the arteries (*Achsenströmung in den Arterien*) and with the pulse, Haller correlates all that was known from earlier literature on anatomy, physiology, and pathological anatomy and combines this with his own results to form an integral whole. I have already attempted elsewhere to assemble what is most important in the chapters on the circulation from the aspect of pathological physiology[8] and will therefore confine myself here to a few brief remarks. For this purpose, let us take the chapters on the heart and pulmonary circulation appearing in the first volume.

Prior to Haller's writings on pathological changes and disturbed functions, an important role is played, on the one hand, by the physiologists from Harvey to Stephen Hales (1677–1761) and, on the other hand, by the anatomical studies of clinicians ranging from Vieussens (1641–1716) to Lancisi (1654–1720) and Senac (1693–1770). Haller in his turn summarizes the essentials from the works of his many predecessors—that is to say, in so far as this is possible, given the abundance of extremely heterogeneous material available—and after an exhaustive account of the physiology of the heart also adds some important references to its pathology. These served among other things as valuable support for Harvey's theories, which at that time were still not sufficiently well established. The examples cited by Haller relate to calcification of the cardiac valves, the repercussions of pulmonary diseases on the heart, mechanical defects of the cardiac valves (especially on the left side of the heart), and the effect of faulty closure of the valves on the shape of the heart. From the details outlined by Haller, the connection, for example, between valvular insufficiency and cardiac dilatation or between stenosis and myocardial hypertrophy becomes obvious. Thus, there are a number of essential elements of modern cardiology which Haller was the first to incorporate into a medical text-book. There is another point to which I think it important to draw attention. In the history of nineteenth-century clinical practice, besides the morphological foundations of pathological anatomy laid by Morgagni and the methodological foundations of percussion and auscultation laid by Auenbrugger and Laennec, the functional conceptions promulgated by Haller in the realms of both physiology and pathology played a major role. This contribution of Haller's to a field of study that had hitherto received scant attention is surely proof enough of his significance. But in addition, Haller also accomplished a great deal purely and simply as a physician, i.e. in elucidating diseases which until his time had been shrouded in mystery.

IV

I must now bring this talk to a close. Before doing so, however, may I add just one thing more. As a man, too, as a flesh-and-blood human being like the rest of us, Haller was an equally great, indeed, a gigantic personality. During the years following his final return to Berne, where he died on 12 December 1777,

he was tortured more than ever before by doubts of a philosophical and religious nature. One has the impression that then, more than in earlier years, he strove to ride out the storm of these spiritual conflicts by immersing himself in unceasing toil. On the one hand, the opium drops he took in ever larger doses helped him to endure his physical pains—which were probably mainly due to vascular disorders—while, on the other hand, he sought relief from the frequent torments of his spirit in the Bible and in the works of religious writers. When one remembers also the suffering and sorrow he encountered within his own family and which dogged him throughout his life, one realizes to what an extent Haller's intellectual and cultural greatness was purchased at the price of personal tragedy. The memory of Albrecht von Haller as a man provides us with a shining example to follow, just as his life-work as a scholar and physician offers us a constant reminder of the duty which it is ours to perform.

REFERENCES

1. D'Irsay, S. (1950), *Albrecht von Haller*. Leipzig. Preface.
2. Zimmermann, J. G. (1755), *Das Leben des Herrn von Haller*, p. 49. Zürich.
3. Hirzel, L. (1883), *Albrecht Hallers Tagebücher seiner Reisen nach Deutschland, Holland und England*, p. 128. Leipzig.
4. Hirzel, L. (1883), *op. cit.*, p. 132.
5. Hirzel, L. (1882), *Albrecht von Hallers Gedichte*. Frauenfeld.
6. Buess, H. (1955), 'Marksteine in der Entwicklung der Thrombose-Lehre', *Gesnerus*, XII, 159–90.
7. Buess, H. (1958), 'Zur Entstehung der "Elementa Physiologiae" Albrecht Hallers (1708–77)', *Gesnerus*, XV, 17–35.
8. Buess, H. (1954), 'Die Anfänge der pathologischen Physiologie auf dem Gebiet der Kreislaufforschung nach Albrecht Hallers Elementa physiologiae', *Gesnerus*, XI, 121–51.