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PETER ARTEDI

A BICENTENARY MEMOIR

WRITTEN ON BEHALF OF THE

SWEDISH ROYAL ACADEMY OF SCIENCE

BY

EINAR LÖNNBERG.

TRANSLATED BY

W. E. HARLOCK.

UPPSALA & STOCKHOLM

ALMQVIST & WIKSELLS BOKTRYCKERI-A.-B.

BERLIN

LONDON

PARIS

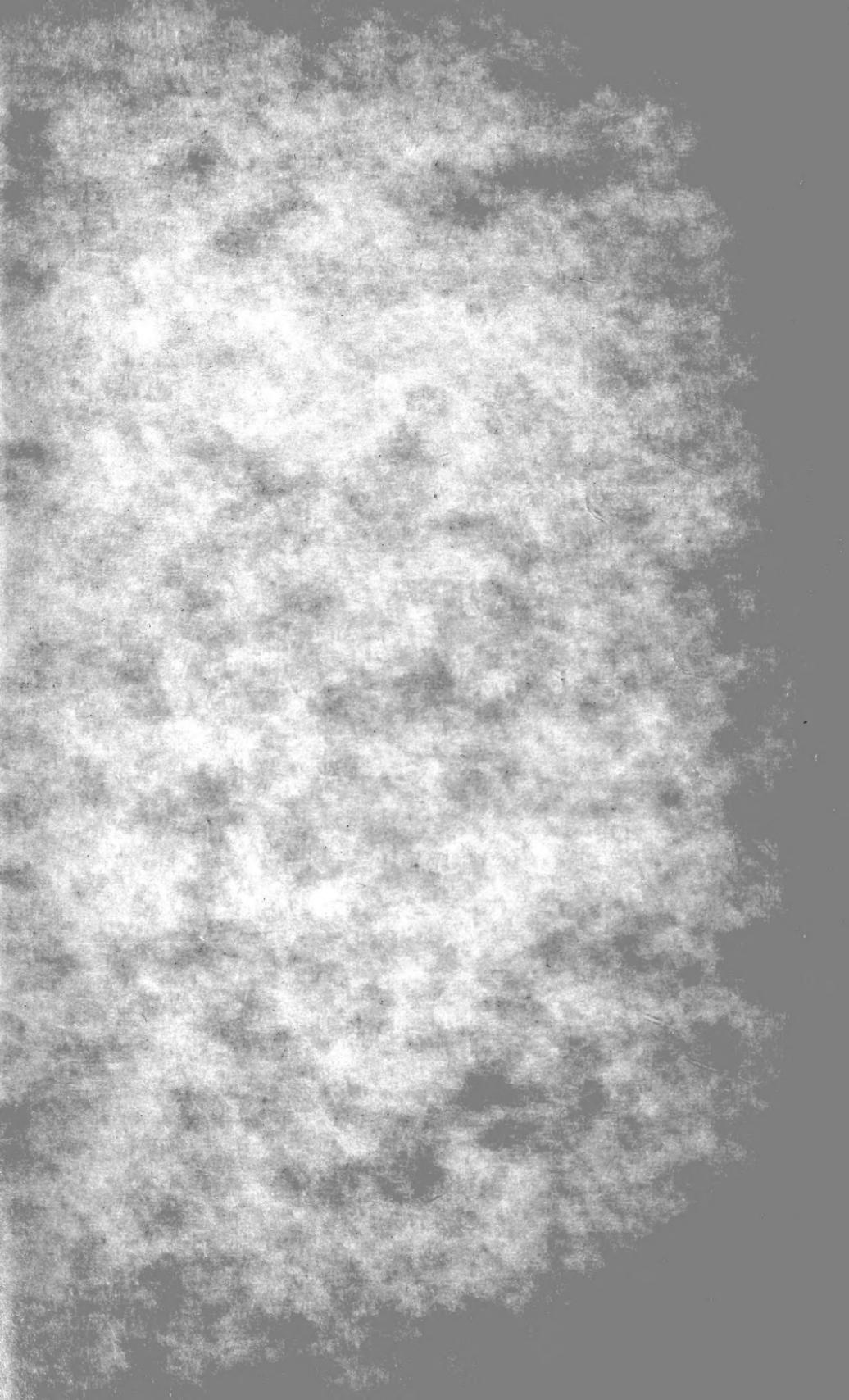
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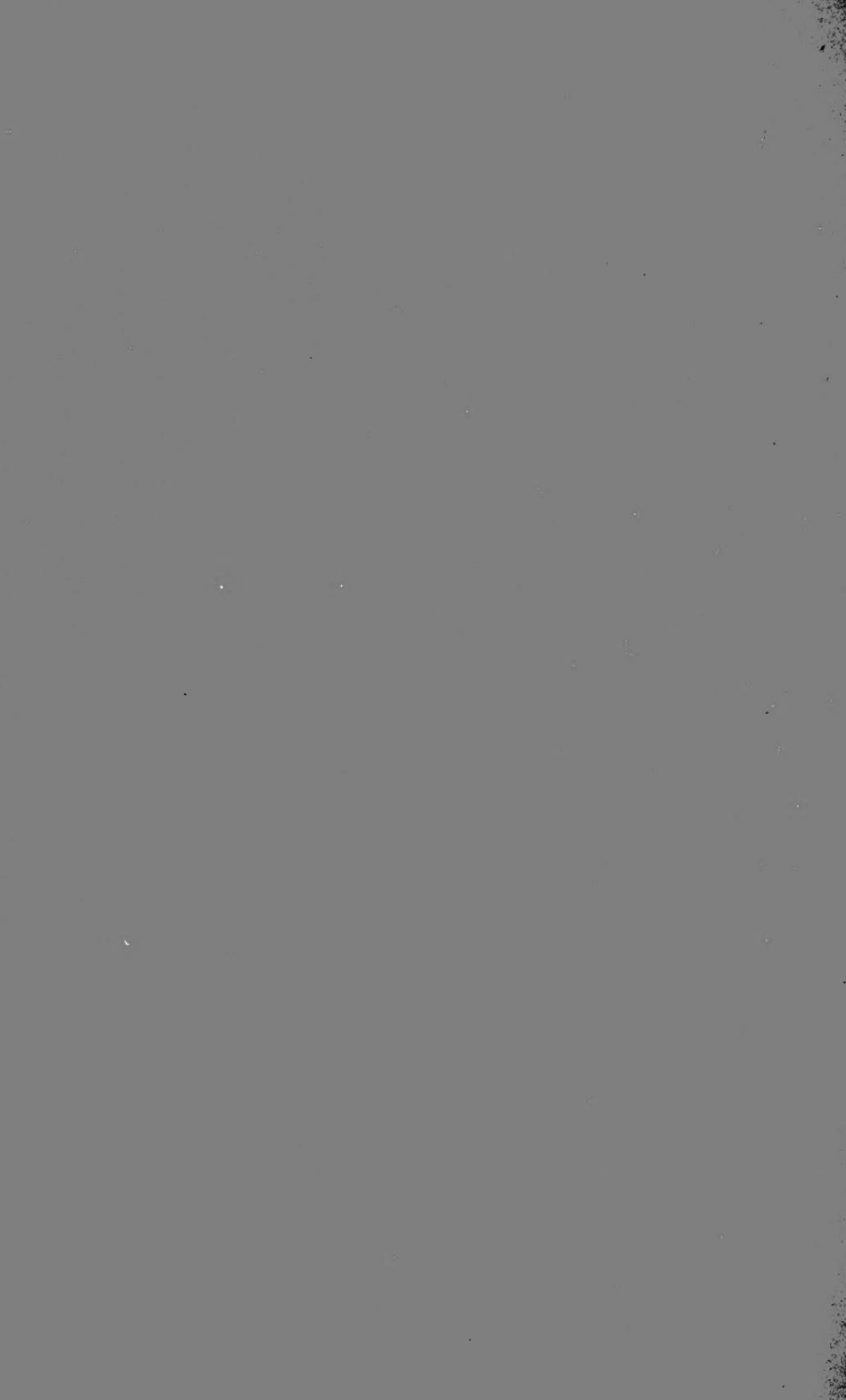
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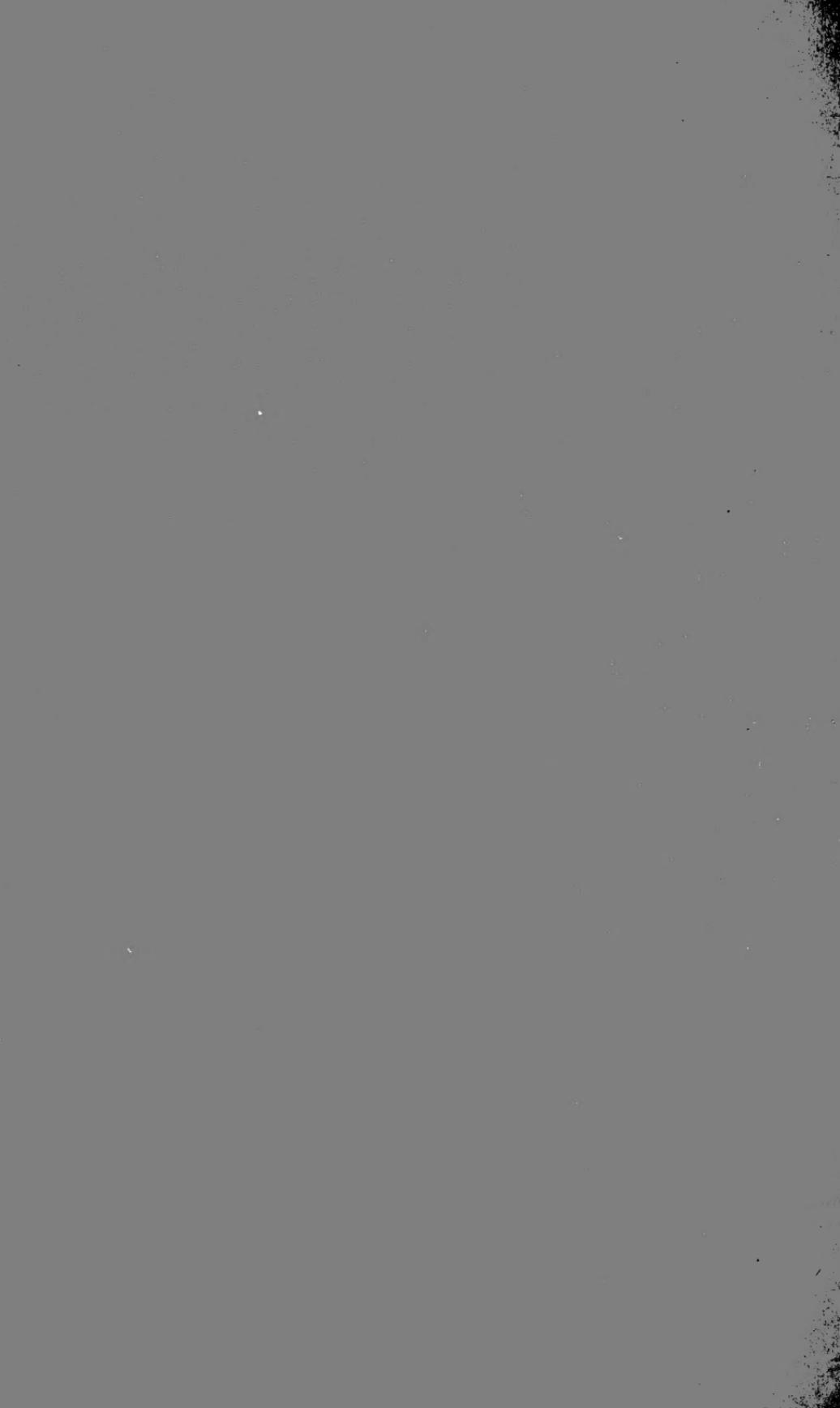
LIBRAIRIE H. LE SOUDIER
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Though comparatively few even of his own countrymen of the present day are familiar with the name of PETER ARTEDI, there are, in fact, not many men on the proud roll of famous Swedish naturalists and scientists who have greater or better claims to be held in honourable remembrance than he, occupying as he does a very prominent place among the pioneers of natural science study. By way of commemoration of the 200th anniversary of this illustrious man's birth, it is here proposed to give a sketch of his brief life and also some appreciation of his significance in the history of biological investigation.

It appears that PETER ARTEDI came of a family which was settled in the Government of Vesterbotten in North Sweden. The first member of the family to adopt the name, which — in a variant, simplified form — his descendant was to make famous, was the son of a peasant farmer residing in the village of Hiske, which is situated in the compass of the rural parish of Umeå.¹ This man was born in 1635 or thereabouts, and called himself subsequently PETRUS MARTINI ARCTÆDIUS. He appears to have decided to strike out a new line, for we find him resorting to the University at Åbo, in Finland, where he matriculated in 1656. Seven years later, on April 3 1663, he was appointed a master at the Piteå Grammar School by the Consistory of the Norrland Diocese, located at Hernösand. He proceeded at

¹ The town of Umeå is situated near the mouth of the River Ume, which flows out into the Gulf of Bothnia. Piteå is similarly situated, about 120 miles further north; Hernösand also lies close to the Baltic Sea, about the same distance SSW. of Umeå.

once to take up his teaching duties at Piteå, but took priest's orders in September of the same year and was presented to the perpetual curacy in his native parish in 1666; there he remained till 1690, when he was promoted to the living of Nordmaling.¹ This P. M. ARCTÆDIUS married a certain ANNA GRUBB, who bore him five children, two of them sons, OLAUS and MÅRTEN.

The former of these two sons, whose date of birth was probably 1670, studied like his father at Åbo University, where he matriculated in 1692. Four years later he was ordained at Hernösand and in 1701 he obtained the perpetual curacy of Anundsjö.² In that year he lost his first wife, DOROTHEA DJUPEDIA. Not long afterwards he married again, his second wife being HELENA SIDENIA, a daughter of PETRUS SIDENIUS, of Stockholm, a Master of Philosophy and a Court Chaplain. There were five children of this marriage, of whom PETER, the future scientist, was the oldest but one. The date of his birth, according to the Anundsjö Parish Register, was February 27 (O. S.) or March 10 (N. S.). The family continued to reside at Anundsjö for upwards of ten years, but in 1716 a document was addressed to the Crown by the Consistory at Hernösand, stating that, whereas the incumbent of the living of Nordmaling, PETRUS MARTINI ARCTÆDIUS to wit, was of advanced age, had been blind for over two years, and was in great bodily distress, they, the Consistory, sought leave to approve an application made by the said incumbent, praying that his son OLAUS might be empowered to succeed him in the discharge of his duties, which application had, moreover, received the unanimous support of the congregation of the parish. In reply thereto an authorisation conferring the father's living on the son, was signed by King Charles XII in Lund on the 26th of September 1716.

¹ A small place on the coast, about 50 miles SW. of Umeå.

² Anundsjö lies about as far (50 miles) from Nordmaling as that place is off Umeå; it is inland, being almost due W. of Nordmaling.

This change of domicile was not without a distinct bearing upon the career of OLAUS ARCTÆDIUS' SON PETER, for the natural features and climatic conditions of the two localities are widely different; thus, the new home would undoubtedly offer, to a lad already alive to the interests of the open-air-world, far more incentives than the old one to pursue an inborn bent for the study of nature. Now in very early life PETER had declared himself a devotee of zoology in general and of fishes in particular; it is, therefore, easy to understand that his father's removal to the shores of the Bothnian Gulf must have been particularly welcome to him, for there he had its waters ready to hand, from which to procure an unfailing supply of specimens and materials for study and investigation. As the climate of Nordmaling, moreover, considering its high latitude, is remarkably kindly, there would be, on that score too, greater opportunities afforded the lad than before of studying nature in her various aspects and of watching the ways and life of animals, birds and fishes in their several natural surroundings.

In the autumn of 1716 PETER was sent to school at Hernösand. Among his schoolfellows he quickly made his mark by reason of the habit he had of devoting out-of-school hours to the dissecting of fishes and the collection of plants rather than to sharing in the ordinary boyish amusements. In class he kept well abreast of his companions, without distinguishing himself by any special brilliance; so soon, however, as he had acquired the rudiments of Latin, he put his knowledge to practical use by greedily devouring the writings of the medieval alchemists. After successfully passing through the lower school, he was promoted to the Gymnasium, or upper school, at Hernösand, and in due course proceeded thence to the university, furnished with the highest certificate awarded.

The university to which he directed his steps was not that of Åbo; for during the troublous times through which the North of Europe had passed in the reign of

Charles XII, that university had been obliged to close its portals, and though by this time reopened and re-constituted, it had not attained to anything like its former status. Consequently it was in Upsala that PETER inscribed his name as a matriculated student, on October 30 1724. As a matter of fact the actual signature in the university register is by another hand, doubtless that of the Dean of the Faculty for the time being; the entry runs: — “Petrus Arctelius Angerm.¹”, thus showing a slight scribal error. In another register, that in which the newly arrived undergraduates inscribed their names and the amounts subscribed to the library funds, we find in PETER’S own hand-writing: —

Petrus Arctelius Angermannius

with the amount paid in: — 4 dalers 16 öre. This signature shows that up to that time he retained the family name in the same spelling as that adopted by his grandfather; it was not till some years subsequently that he assumed the variant by which he is known to fame.

It was originally intended that he should devote himself to the study of theology at the university, that he might in due time follow in the footsteps of his father and grandfather and perhaps even succeed to the living of Nordmaling. His own pronounced bent, however, in another direction forbade him to adopt that course in obedience to his father’s natural desires on his behalf; the keen interest he had felt in natural history as quite a boy, and the taste he had imbibed

¹ Angerm[annus] denotes: — “From the District of Ångermanland”. Undergraduates at Upsala (and Lund) are classed in “Nations”, according to the parts of the country from which they come. The joining of a Nation is an obligatory preliminary to matriculation. Each Nation has a club-house of its own, and administers scholarship funds &c. for the benefit of its members.

for inquiries kindred to those of the alchemists of the Middle Ages, asserted themselves too powerfully within him to suffer gainsaying, and accordingly his father's repeated injunctions and warnings to him to shun the pursuit of worldly and pernicious objects of study were foredoomed to be of none avail.

The choice thus made by PETER ARTEDI of natural science, in preference to theology and philosophy, as the branch of knowledge he was resolved to apply his energies to, was a notable one apart from the breach it signified with family traditions, for at that time the study of natural science as an end in itself may be almost said to have been non-existent at Upsala; thus, for instance, ARTEDI is reported to have been the only man of his day who went in for chemistry. It should be mentioned that he had to attach himself to the Medical Faculty, for it was only under its auspices that any instruction in natural history was then imparted. Of the professors belonging to that faculty there were two who had made themselves famous for a relatively speaking wide acquaintance with natural history, they having both done some amount of original investigation. In 1724, however, both these professors were well advanced in years and had all but retired from taking any share in teaching work. One of them, LARS ROBERG, was 60 years of age when ARTEDI matriculated, and though he was a fair zoologist and a skilled anatomist, yet the teaching he did while ARTEDI was up at the university must have been very small in quantity; there is no record, for instance, of his having held any course of public lectures at all. Moreover, what was still more serious, there existed at that period practically nothing in the way of collections or other educational materials for natural history study, since the few curiosities that ROBERG possessed can hardly be said to deserve the name of a collection; furthermore, in the allotment of subjects among the several professors, Zoology had actually not fallen to ROBERG'S province.

The other professor above alluded to was OLOF RUDBECK, the Younger, a very gifted and learned man, indeed, but one who had been drawn away from his researches and teaching in natural history by his great interest in language study; thus, for the first three years of ARTEDI'S undergraduateship RUDBECK was, as a matter of fact, entirely inactive in his prescribed department, on account of his being engaged in scientific inquiries in the domain of philology. On resuming his professorial duties in 1727, at the age of 67, he gave a two-year course of lectures on the Birds of Sweden, and ARTEDI was then among his auditors.

From the above-related facts it will be abundantly clear that the natural science student in ARTEDI'S day must have been very largely dependent upon his own private studies for the knowledge he wanted to acquire; the university staff was not in a position to afford him more than the most meagre assistance. LINNÆUS comments upon this total want of facilities for natural science study as follows: — "RUDBECK gave a course, certainly, about his *Birds of Sweden*, which by the way are cleverly drawn, and ROBERG lectured privately on the *Problemata* of ARISTOTELES in the light of the principles of DESCARTES, but no one heard or saw any Anatomy, nor anyone any Chemistry; I myself never had the opportunity of attending a single lecture on Botany, either private or public". In spite of these untoward circumstances ARTEDI applied himself with great assiduity to his science, and thanks to his good parts he was soon accounted one of the most promising of the students in the Medical Faculty, as is, moreover, proved by the incident related below.

LINNÆUS, on arriving in Upsala in the year 1728 for the purpose of taking up natural science study there, made inquiries as to what men were already engaged in the same kind of work, that he might perchance make their acquaintance and so obtain some guidance that would facilitate his own progress in learning. On all hands he was informed that PETRUS ARCTÆDIUS was

the man he ought to get to know, he being the most advanced in acquirements and the keenest in application in the department which LINNÆUS meant to make his own. For the time being, however, a meeting between the two future scientists was precluded, by reason of ARTEDI having been summoned home to Nordmaling to his father's deathbed.

ARTEDI appears to have prolonged his stay at his home till the close of that year and well on into the following one. Though he was doubtless much absorbed in the family arrangements consequent upon his father's decease, there is proof that he did not wholly lose sight of his scientific interests in the shape of a manuscript, preserved in the Upsala University Library, entitled "A Short List of the Trees, Bushes and Plants that are Indigenous to the Glebe-Lands in Nordmaling and the Villages lying in its Immediate Vicinity". This manuscript bears date: February 24 1729, but his return to Upsala must have taken place shortly afterwards, for he is reported as having participated, in the capacity of Opposer, at the keeping of an Act at his nation-house on the 2nd of April.

As soon as LINNÆUS received news of ARTEDI being in Upsala again, he hastened to go and see him in order to make his acquaintance, and wrote subsequently, in his Introduction to ARTEDI's "Ichthyologia", concerning the impression made upon him at this first meeting as follows: — "I saw him before me, lofty of stature and spare of figure; his hair was long and his face reminded me of JOHN RAY's¹; he struck me as humble-minded, not hasty in forming an opinion, but yet prompt, firm and withal mature, a man of old-world honour and faith. It rejoiced me to remark that our talk turned at once upon stones, plants and animals, and I was much moved at having so many of his scientific observations confided to me without the least hesitation or reserve upon that very first occasion on which we met. I sought

¹ The English natural scientist, 1628—1705.

his friendship, and so far was he from withholding it, that he promised me his services too, if such I needed, — a promise he afterwards most loyally kept. This sacred friendship, thus spontaneously sealed, we fostered uninterruptedly for seven years in Upsala, at all times with the same fidelity, but with ever-increasing warmth and attachment. He was my closest and most intimate friend and I was his”.

The bond of friendship and fellowship between the two lasted through life, and proved not alone a source of mutual joy, but likewise a factor of the utmost importance in their several careers as scientific investigators and scholars. The intercourse they had with one another is yet further dealt with in the above-mentioned Introduction and in “Autographic Notes by LINNÆUS concerning Himself”, published in 1823; in the latter he proceeds to characterise his friend in comparison with himself in the following manner: — “ARTEDI was of a more retiring disposition than I, more seriously minded, more attentive to details, slower in observation and in everything he did, but, on the other hand, more accurate. As for myself, I was quicker in the actual doing of any piece of work, ARTEDI being prone to a certain extent to procrastinate; it did not, however, seldom happen that he had the laugh of me, by reason of my having to begin my work all over again because some important fact had escaped my memory.”

“It was inevitable”, LINNÆUS continues further on in the same work, “that a certain degree of good-natured rivalry should assert itself now and then between us. Thus, when I despaired of ever attaining to the same degree of familiarity with the lore of the alchemists that he was possessed of, I had reluctantly to acknowledge the fact and relinquished from that time forth the pursuit of that study altogether; he, again, to keep the balance true, as it were, obligingly desisted from the keen inquiry he had previously been following up in the department of Botany, which I was making

my own¹. Both of us eagerly took up the study of the different branches of natural science, and continued our investigations with unabated vigour and zeal until such time as we were, either of us, forced to confess that the other had outdistanced us, whereupon, acknowledging our defeat, we left the field to the more successful combatant in the struggle. Thus, after protracted labour to attain premier position in the department of Ichthyology, I was finally fain to admit my inferiority to my rival, and thenceforth I left that subject entirely in his hands, as also the study of Amphibia², while, on the other hand, he willingly acknowledged that I was ahead of him in knowledge of Birds and Insects. In Mineralogy and the study of Quadrapeds (Mammals), again, we kept fairly abreast of each other."

"Every observation which the one of us succeeded in making earlier than the other, gave occasion to a brief pang of a species of jealousy and prompted each to the keeping secret of such discoveries for the future; but the mutual feelings of genuine friendship and admiration we entertained, rendered those momentary resolves of none effect, and the daily intercourse we had together derived much of its *raison d'être* and value from the open-hearted way in which we communicated to one another the results of the researches we were making."

"The rivalry between us encouraged us in our efforts and spurred us on to greater industry and diligence in our work. Not a day passed without one of us going to see the other, and that, though the distance between our dwellings was somewhat great. We reported to each other unreservedly whatever happened to us, whether it was of a joyous or sorrowful nature. In that wise we each derived the sweet consolation of possessing a true companion and a sympathiser in all

¹ In another place this statement is qualified by the note that ARTEDI reserved himself the right of still studying the Umbelliferæ, for he intended to work out quite a new method of treating them.

² According to the nomenclature of that day, the Amphibia embraced both Reptilia and Batrachia.

the vicissitudes of fortune, and could experience the joy of sharing each other's prosperity and adversity at all times and seasons."

"An instance may be cited to show the quality and depth of our mutual attachment. When I was on the point of starting for far-distant Lapland, I ordained and appointed ARTEDI to be my sole heir and legatee in respect of all those my manuscripts and collections of natural history specimens, he solemnly undertaking and engaging to have such of them published and given to the world as might be deemed worthy thereof, for the event of the enterprise I was about to embark upon proving one from which I was not destined to return alive. He, again, on leaving Upsala for England, directed to be handed over into my keeping and for my use those of his books which he could not conveniently take with him on his journey, at the same time writing me word, who was then travelling on a tour of scientific investigation in Dalarna, that I was to take charge of the said books, and that they were to become my property, if Fate ordained that he should never come back to his native land again."

In addition to the above statements LINNÆUS also makes some comments upon his friend's capabilities and acquirements in other departments of knowledge than natural history. "He was exceedingly well versed in litteræ humaniores and in modern languages, was a profound philosopher, and possessed a sound knowledge of medicine; he had the power, moreover, of giving the most admirable addresses on very various subjects, wherein he displayed keen judgment and a thorough acquaintance with his topic, so that none of his hearers, on leaving the lecture-room, could fail to accord him the distinction of being a very great and learned man."

The above quotations, it should be remembered, are from the pen of the man who was best qualified to form an estimate of ARTEDI, both as a personality and a scholar. That they were prompted by feelings of genuine attachment, mingled with profound sorrow

at the all too early removal of his friend, we cannot doubt, but that circumstance by no means detracts from the value to be attached to them. While recognising to the full the great and brilliant gifts with which LINNÆUS was endowed by nature, we may nevertheless venture without undue temerity to assume that ARTEDI was very considerably instrumental in assisting him on his path towards distinction as a scientific man. Being by some years the elder of the two, ARTEDI had already attained, as we have seen, a reputation for learning at the date of LINNÆUS' arrival at the university, and was, therefore, in a position to afford him advice and assistance of various kinds; he could, in short, become in some wise LINNÆUS' teacher and guide as well as his friend and comrade. We have LINNÆUS' own authority for knowing that ARTEDI was always most willing and eager to lend him all the aid he possibly could. Doubtless the most fruitful feature of their intercourse together was those frequent talks they had in each other's rooms, when they had an opportunity of communicating to one another and discussing what they had each been engaged in learning or studying, and of disputing about the conclusions they were themselves to come to upon each matter in hand. On those occasions the various opinions and statements of their predecessors in natural history investigation were keenly debated, new theories were evolved and criticised, and ultimately approved or discarded.

The two young men differed so much in disposition, and their abilities were so widely diverse in character, that they complemented one another in a singularly happy manner. LINNÆUS, "small of stature, boisterous, hasty and of ready wit", as he characterises himself in his youth, was possessed, we may be sure, of a more active imagination and was consequently the readier with new ideas or theories, whereas the somewhat sluggish ARTEDI was more deliberate, though always more severely logical, in forming and expressing his judgments. Hence it might often happen that the

latter "had the laugh of his friend", as he proceeded to demolish with the pruning-shears of his relentless logic the all too luxuriant offshoots of the other's fertile fancy. But just as a wise pruning conduces to strengthening a tree and causes it to bring forth fruit more abundantly, so did the unsparing, yet always temperate and kindly criticisms that ARTEDI passed upon his friend LINNÆUS' early scientific labours, contribute not a little, we may safely conjecture, towards developing and bringing to maturity those great gifts with which he was by nature endowed. ARTEDI's influence, doubtless, made itself felt most in the department of systematisation, for it was there that he was himself strongest, as may be seen throughout the whole of his own scientific production. The benefits were not wholly on one side, however; for it may be presumed that ARTEDI, who was "tardy and serious-minded", stood in need of just that kind of stimulus which LINNÆUS, with his superabundant fertility of ideas, was so eminently qualified to afford; and in temperament, too, LINNÆUS, a native of the milder, cheerier South of Sweden, would exercise a beneficent influence upon his comrade from the bleak forbidding North, by chasing away with the exuberance of his youthful high spirits that gloomy depression to which Northerners are wont to be prone. Thus the two bosom friends were admirably suited to one another and their friendly intercourse and cooperation in scientific pursuits undoubtedly bore rich fruit in their future productions.

Of the participation of ARTEDI in the undergraduate life of his time but few notices have come down to us. Here and there in the pages of "*Acta Nationis Angermannicæ*" may be found a mention of his name; to the effect that, for instance, he was promoted in his seventh session to the class of 'Seniores' in his Nation and was later elected 'Curator', or official Head and Representative, of that undergraduate association; that he did duty as Opposer at the keeping of an Act, and that in 1734, at Easter, he undertook to hold a public

oration. The subject he treated on that occasion was, curiously enough, not one chosen from his own department of learning; it was entitled "De Serie Philosophorum a Condit. Mund." In explanation of that, at first sight, strange circumstance, it may be noted that it was quite in accord with the usage of that day for some such topic to be dealt with on those occasions; nor was, indeed, the study of philosophy itself so alien to the bent of ARTEDI'S¹ mind as might be supposed from the general tenor of the works by which he made himself famous. On the whole, it would seem from the scanty data preserved to us that ARTEDI, without distinguishing himself in any special way among his fellow-students, contributed his part to such undergraduate social life, and took his fair share of such administrative work in his Nation, as may have existed or occurred at that day.

As his university course lengthened out and he found himself advancing in years, anxieties as to the future began to occupy his attention. It is easy for us to imagine the gradually increasing discontentment he must have felt at having spent so long at a seat of learning so poorly equipped as was the Upsala of his time in the special branch of knowledge to which he had devoted himself, and the consequent desire that took possession of him to find some means of extending his horizon by going abroad, in order to pursue his studies in more stimulating surroundings. He had, indeed, for some time been in the receipt of a scholarship, which had assisted him to defray the cost of his maintenance at Upsala, but he now bethought himself of endeavouring to obtain such aid as would enable him to travel and study at first hand those collections and materials belonging to his science which were so essential to his progress. From the register of the scholarship funds distributed by the University we can see that his teachers had early rewarded him to the

¹ From the work cited we find that it was while Curator that A. adopted this simplified spelling of his family name.

extent of their power, but beyond a definite amount and a prescribed number of years they could not support him, by reason of the limited means at their disposal and the need of exercising due fairness to other applicants. For two years, consequently, he had been without such pecuniary aid, when his position appeared to him so precarious and unsatisfactory, that he resolved to appeal to his relatives for assistance. For a man of his retiring and modest disposition such a resolve must have meant many pangs and inward struggles, but at about midsummer in the year 1734 he summoned up enough courage to lay his case before his two brothers-in-law, PETER BIUR and JONAS LJUNGBERG, who both resided at Umeå, the former being a business man and the latter a clergyman. The reception he met with at their hands was more encouraging than he had dared to hope; the wishes he entertained they fully entered into and wholly approved of, so that the money and other equipment he was in need of they promised to supply.

At that period it was obligatory for any undergraduate who was proposing to go abroad for the purposes of study, to sit for a theological examination, and pursuant to that ordinance ARTEDI successfully passed the test, on July 17 in the same year, as is briefly registered in the minutes of the Theological Faculty: — "July 17. PETRUS ARCTEDI (*sic*), Student of Medicine, who is about to travel abroad, duly examined." That preliminary over, it only remained for him to obtain the sanction of the Academic Consistory, in whose minutes for July 31 1734, may be read: — "§ 6. Resolved that in behalf of PETRUS ARCTEDI Angermannus, Student of Medicine, an Academic Certificate shall be issued, seeing that he has declared his intention to travel abroad, and that he has been duly examined in Theology pursuant to the ordinance enjoining the same."

Being thus fitted out with the pecuniary means and the academic passport for making his way smooth, he embarked in Stockholm, in the month of September 1734, on a vessel bound for England.

Concerning his experiences on the voyage we have no record, nor indeed any very definite one of the more important matter as to what places and institutions he visited in England. We can, however, be sure that he made the best possible use of his time, one evidence of which is to be found in the dating of the preface to his ichthyological works from London, 1735. The only extant account of his doings in England is what LINNÆUS reports of the conversations they had together when they unexpectedly met in Leyden on July 8 1735. LINNÆUS was temporarily resident in Holland at that time and happened on the above date to go to Leyden, where ARTEDI, who was on his way back to Sweden, was tarrying with a view to acquiring the doctor's degree. It is easy to imagine what a source of mutual delight and satisfaction this unlooked-for recovery of each other must have been. More than a year had passed since the two had parted in Upsala, and by reason of their having been constantly on the move in the meantime they had not been able to communicate with each other. Hence there would be much for both to relate; of ARTEDI's sojourn in England his friend received a very glowing report; the great and excellent opportunities afforded him for studying Ichthyology, the extreme good fortune vouchsafed him in the friendships he had made with learned men and the profitable intercourse he had had with them, all combined to render his recollection of his visit an exceedingly pleasant one. He expressed to his friend in the warmest terms his sentiments of gratitude for, and appreciation of the many marks of consideration and goodwill that had fallen to his lot in England and declared his firm attachment to, and unalloyed admiration of both the country and its people. Of those with whom he had been privileged to come into contact he specially mentioned SLOANE,¹ the celebrated naturalist, and spoke with grateful recognition

¹ S. was born in Killileagh, Ireland, in 1660. At his death in 1753 he was Physician in Ordinary to King GEORGE I and also President of the Royal Society.

of the extreme kindness and consideration he had been the recipient of from him in particular. His stay in England, however, had almost exhausted his resources, and he informed LINNÆUS of the great anxiety he was in lest his means should not allow of his spending the requisite time in Holland and procuring the necessary books for qualifying himself for the degree he was desirous of obtaining before returning to Sweden; he was, indeed, afraid he would be obliged to go home without further delay. Another fate was, however, in store for him.

At that time there was living at Amsterdam a wealthy chemist of the name of ALBERT SEBA.¹ He had made himself a name as a natural scientist by reason of the zoological collections he had got together, which for that age were exceedingly large and notable. The various valuable specimens in these collections he was anxious to have reproduced in print with elucidatory descriptions; two bulky folios had already (in 1735) appeared, dealing with Quadrupeds and Snakes, and now he was desirous of getting Fishes (& Lower Animals) treated in like manner for a third folio volume. Owing, however, to increasing age and feebleness, he felt unable to accomplish that himself single-handed, and was therefore on the look-out for a likely collaborator. LINNÆUS had been requested to undertake the task, but had declined owing to other work in which he was more interested, Fishes being by no means a favourite study of his. On meeting ARTEDI, though, he recalled to mind the request which SEBA had made to him, and in the full persuasion that no better collaborator could be found for the work in hand, he induced ARTEDI to return to Amsterdam with him and offer SEBA his services. The assumption was, naturally, that the remuneration offered would be liberal, and that ARTEDI would thereby be placed in a position to carry out the ardently cherished wish of getting his doctorship before leaving Holland.

¹ Born 1665. Died 1736.

LINNÆUS was busy at that time preparing the first edition of his "Systema Naturæ". ARTEDI was able to give him as a contribution to that work a survey of his own system of classification of Fishes, including detailed descriptions of the different genera and, furthermore, an intimation of the classification of the Umbelliferæ, which he had devised with special reference to the occurrence of the involucre, a classification which he hoped to work out more thoroughly when he should have completed his labours upon Fishes. As soon as LINNÆUS had had time to incorporate these contributions in his own work, the two friends betook themselves to Amsterdam and waited upon SEBA. The result of the interview was, that ARTEDI undertook, "on the promise of a fair and honourable remuneration", to deal with SEBA'S collection of fishes. He set to work at once to write descriptions of genera and species, and to investigate the synonymy, the work making excellent progress under his hands.

LINNÆUS, after the introduction of his friend to SEBA was accomplished, returned naturally to his own labours at Leyden and Hartecamp, but had no sooner got his "Fundamenta Botanica" finished, than he experienced a great desire to resume personal intercourse with ARTEDI as in the old days at Upsala, that he might consult him and hear his advice and suggestions. Armed with his newly completed work, therefore, he journeyed to Amsterdam to lay it before ARTEDI. His reception there was as cordial as ever, the visit proving, indeed, very opportune and welcome, inasmuch as ARTEDI, too, had a work ready to submit to his friend's approval, his "Philosophia Ichthyologiæ", which he proceeded to read aloud from beginning to end. LINNÆUS tells us¹, "Though anxious to get to work at other tasks, I was not allowed to depart until I had looked through all his ichthyological works and communicated to him those criticisms which occurred to me concerning the

¹ In the above-mentioned Introduction to ARTEDI'S "Ichthyologia".

laws of systematisation which he had there evolved. In every particular case, however, where I had any suggestion or criticism to offer, he seemed prepared to vindicate his own opinion to my entire discomfiture". ARTEDI mentioned also, at the same opportunity, that he meant to publish in collected form the works he had up to then written, and that he was only waiting until his task for SEBA should be completed, to revise and touch them up finally so as to make them ready for the printer. Before LINNÆUS bade him goodbye ARTEDI showed him all his notes and his manuscripts, a thing he had never done before in spite of their intimate friendship. "In this way I had been detained", says LINNÆUS, "far beyond the time I had intended to stay, and our colloquy had far exceeded the limits usual with us, but, though my patience at the time was beginning to fail, I would gladly have had our meeting continue much longer than it did, had I known it was to be our last."

A few days later, on September 27 1735, ARTEDI was a guest at SEBA'S house. The evening passed rapidly in lively converse with a number of congenial friends, and it was rather late when ARTEDI left to go home. In the darkness of the night, as he was groping his way along the streets, with which we may conclude he would not be very familiar, he stumbled, and, falling into one of the many canals that line the streets of that city, was drowned. Thus, in such sorrowful wise, was a period put to a career of great promise. At the age of only 30 years the keen and gifted naturalist was removed from the scene of his labours by so simple yet fatal a misadventure.

The accident was discovered on the following day by the recovery of the body; this was first removed to the City Hospital, and thence taken for decent and seemly burial¹ by the man with whom ARTEDI had

¹ ARTEDI was buried on October 2 1735 (O. S.). From an extract taken from the Register of Deaths for the City of Amsterdam we learn that his last dwelling-place was in Warmœstraat, near Nieu-

lodged. LINNÆUS, who only heard, from a fellow-countryman, of the sudden and deplorable event, which had deprived him of his best friend, two days after its occurrence, hurried to Amsterdam as early as possible, but found all provision made at the charge of SEBA, who, as LINNÆUS says, 'very liberally' allotted a sum of 50 florins towards the burial expenses. It is a little difficult for us to understand wherein the liberality consisted, for during the whole time he had been working for SEBA, ARTEDI had been living at his own expense. LINNÆUS would seem to be using the expression in an ironical sense; he himself certainly met with a far more really liberal and generous treatment at the hands of those Dutchmen and others in whose service he was engaged. Nor does SEBA, as we shall see, come out well in the light of subsequent events.

The profound grief which LINNÆUS felt at the premature decease of his friend finds fitting utterance in the following striking passage in his writings: — "When I beheld his lifeless body stiff and stark, and saw his livid lips filmed with the frost of death; when I reflected upon the unhappy fate of this my best and dearest friend these many years past; when I recalled to mind the innumerable sleepless nights, the countless hours of strenuous labour, the wearisome and perilous journeys, and the heavy expense in various ways, which the man now lying dead before me had been fain to undergo and submit to ere he could attain to that standard of learning which

webrugsteg, and that he was buried as a pauper in St. Anthony's Churchyard. That burial-ground was some years ago appropriated to other purposes, part of it being allotted as building-land to a Primary School and part added to the University Botanical Gardens. There will never probably have been any monument raised to mark where the penniless foreign student was laid to rest, and doubtless the spot and the event were soon forgotten. An opportunity has now, however, been afforded the admirers of ARTEDI's career and work to record for coming generations that gratitude is felt for what he achieved, inasmuch as leave has recently been obtained to have a simple stone raised in the Gardens of the Royal Zoological Society "Natura Artis Magistra", in the city where he met his death.

enabled him successfully to hold his own with all comers; when, I say, these things were borne in upon me, I burst into tears. Anticipating, further, as I did, that all the knowledge he had acquired, which would in fulness of time have conferred undying fame upon himself, have reflected unfading glory upon his country and have rendered the scientific world untold services, was through his untimely death in imminent danger of being irrevocably obliterated, I perceived that the devotion I cherished for my friend demanded it of me, that I should fulfil my share of those vows we had aforetime most solemnly made to each other, that the one of us who should survive the other would regard it as a sacred duty to give to the world what observations and investigations might be left behind by the one who was gone."

In the carrying out of this pious resolve, however, LINNÆUS was confronted with serious obstacles. On application to ARTEDI'S relatives in Umeå, he readily obtained their consent to his taking over all the manuscripts; the only condition they made was, that they should be published, which LINNÆUS faithfully promised to do without any alteration whatever in their tenor. So far, so good; but when he applied to the man with whom ARTEDI had lodged, he found that there was no possibility of persuading him to hand over the manuscripts, owing to the claim he had upon the deceased man's estate for arrears of rent and accommodation provided. As mentioned above, SEBA had not remunerated ARTEDI at all for the services he had rendered, and consequently the latter had been obliged to run into debt. All the efforts LINNÆUS made to come to terms with the landlord proved futile; he obdurately insisted on his rights and refused to yield up any of the effects ARTEDI had left. Under these circumstances LINNÆUS bethought himself of applying to the man in whose service ARTEDI had been working and on whose behalf he had incurred the debt, in the hope that he would be willing, as an act of Christian charity if he did not feel it to be

his bounden duty, to redeem out of the landlord's keeping ARTEDI'S effects, including his manuscripts, and to retain them until such time as LINNÆUS should have succeeded in procuring the necessary means from Sweden to discharge the debt himself. As matters then stood, LINNÆUS could not but entertain fears lest the landlord might dispose of the possessions by auction to recoup himself for the money he was out of pocket, and that by that means the precious manuscripts would be scattered in various directions. This appeal to SEBA, however, justifiable as it was, proved of no avail. The purse-proud man revealed himself in his true colours by making shuffling excuses to the effect that he had no desire to be mixed up in the affair, that it was no concern of his, etc. He even went the length of endeavouring to persuade LINNÆUS that the best solution would be for the things to be put up for auction, for there was no one in Amsterdam but himself who would trouble about purchasing them, and that when they had, by that means, come into his possession, LINNÆUS would be able to have access to them. Plausible as that reasoning might seem to its originator, LINNÆUS was too shrewd to be taken in by it. He considered the advice "utrinq̄ue cornutum, anceps et periculosum", and determined to look elsewhere for the assistance he so sorely needed for rescuing his friend's property. Fortunately he was not obliged to search long; his newly acquired patron and friend, GEORGE CLIFFORD¹, on hearing of the matter, at once promised to pay the sum desired. When he had thus acquired the proprietary rights to the manuscripts, he had them copied and then handed over to LINNÆUS the copies so made. Thus it was that, after much anxiety and considerable labour, LINNÆUS was able, thanks to CLIFFORD'S generosity, to

¹ An Englishman by birth who was resident in Holland. He was the owner of very fine botanical gardens at Hartecamp, situated between Haarlem and Leyden. He was also Head of the Dutch East India Company. Concerning his liberality in promoting LINNÆUS' studies, see Prof. TH. M. FRIES'S work, entitled "Linné".

give to posterity the works of his friend ARTEDI. They appeared in Leyden in 1738, under the title "Petri Artedi Sveci, Medici Ichthyologia sive Opera Omnia de Piscibus", and have assured to ARTEDI for all time the honour of being the Father or Founder of the Science of Ichthyology; they possess, however, a still greater import in the history of the development of zoological science generally, as will be seen from what follows.

In order to arrive at a just estimate of the work achieved by ARTEDI and its significance in the history of scientific investigation, it is essential for us to keep in mind three factors materially bearing upon the matter, viz. the general standpoint of natural science at the time he began to study it, the great difficulties and obstacles he had to contend with and surmount in the pursuit of learning, and the early age at which he died. The first work he produced, dealing, it will be remembered, with the flora of Nordmaling, was not published until the present year; practically speaking it has, as might be conjectured, only a historical interest; it contains, certainly, an excellent account of the Nordmaling flora of that time, and the names of certain Swedish plants that are given in it are of interest just now, when the subject of nomenclature is being so much debated; its form, too, lends it a certain degree of linguistic interest from the quaint phonetic spelling adopted, though that by no means constitutes its only claim to our notice. It is plainly a reflex of the works of the celebrated botanist TOURNEFORT, more especially of his "Institutiones Rei Herbariæ" (Paris, 1700), to which reference is made in it. Though we can unmistakably discern that TOURNEFORT'S system formed the basis of ARTEDI'S work, it would be an error to suppose that the Swedish naturalist blindly followed his French forerunner. It is true that, in the works of both, the classes that embrace trees and bushes occur by themselves and separated from the classes of the herbaceous phanerogams which include the cryptogams, but whereas TOURNEFORT finishes up with trees and bushes, ARTEDI begins with them,

and has besides introduced quite a number of independent alterations in the classification, which at any rate in part must be regarded as improvements. TOURNEFORT'S system has 22, ARTEDI'S 25 classes. These classes are resolved into orders or sections. As a basis of subdivision are principally employed characters present in the appearance and nature of the flower and the fruit, but also in the relative positions of these, one to another. TOURNEFORT paid considerable attention to the two first-named groups of properties; that ARTEDI, on the other hand, perceived the value of the third, is a great point to his credit, as it was not until far later that its actually great importance in a systematic regard was recognised and insisted upon by botanists generally. Of the definite improvements in ARTEDI'S classification, as compared with his predecessor's, some few may be pointed out here. Coniferous trees and the birch-alder group were not differentiated by TOURNEFORT; ARTEDI classifies them in two sections. The bird-cherry is recognised by ARTEDI as possessing stone-fruit, and is marked off in a separate section from bilberries, red whortleberries and their congeners; TOURNEFORT, on the other hand, places not only all these but also the elder-tree, the honeysuckle and others in one and the same section. The division in ARTEDI'S work embracing *Ribes*, *Berberis* and *Rhamnus* is of course heterogeneous, yet he has at all events relegated *Rubus* to another place, which along with some others was classified by TOURNEFORT in the same section as the above. Practically all the cryptogams are treated by TOURNEFORT as constituting one class of two sections, one of which, however, is also made to include not only algæ but corals, bryozoa, spongiæ and many other lower-type marine animals. ARTEDI, again, accords two classes to the cryptogams, containing six sections, viz. 1) algæ; 2) lichens and mosses; 3) permanent tree-fungi (amadou), which appeared to him to differ essentially from: 4) the perishable earth-fungi; 5) typical ferns; and, finally, 6) the *Osmunda* and hair-moss. Horsetail and nettles, according to ARTEDI, are far apart

in different classes, whereas TOURNEFORT places them along with hemp, the hop, spinach, *Mercurialis* etc., in one section. Again, *Pyrola* and water-lilies differ so much in ARTEDI'S view that they are referred to quite separate classes, but TOURNEFORT crowds them into one section along with *Hypericum* or St. John's wort. Similarly, he gives in one section *Geranium*, *Caltha*, *Spiræa* and others, for each of which ARTEDI reserves a special section.

Though some of ARTEDI'S classifications seem to a modern botanist strange in the extreme, yet it should be borne in mind that TOURNEFORT, a very renowned specialist in botany, had only shortly before committed what, from a modern point of view, must be regarded as blunders of a still more astonishing character. The few details briefly given above will suffice to show that in this first performance of his in the department of botany, ARTEDI gives clear evidence of having followed up independent lines of thought and of being endowed with considerable talent as a systematiser. His work, however, in this field was, as a matter of course, without any effect upon the development of botanical research, for there was never published anything by his hand on this subject save the short suggestion as to the classification of the Umbelliferæ according to the presence and occurrence of the involucre leaves, which found a place in the first edition of LINNÆUS' "Systema Naturæ".

Quite otherwise is the state of things we find on turning to Zoology. In that science ARTEDI achieved foundational work, quite comparable in many respects to what LINNÆUS effected in the science of Botany. The "Ichthyologia", by ARTEDI, consists of five sections, the contents of which it is here proposed briefly to enumerate and describe. The first bears the title, "Bibliotheca Ichthyologica". In it the author gives us a critical and analytical review of the literature on Fishes from the earliest times, as far as he was acquainted with it; he commences with "Linus Poeta apud Theba-

nos Clarus", and concludes with a short academic dissertation by GERINGIUS, which was published in 1727 and publicly discussed in Upsala (with ROBERG presiding). By far the most important of the works dealt with is WILLUGHBY'S "De historia Piscium libri quattuor", which was posthumously edited and published in 1686 by JOHN RAY. As that work may be said to have constituted really the only groundwork upon which ARTEDI was able to base his own studies and investigations, it may be as well to say a few words about it, so as to illustrate the stage of development to which the science of Zoology had then attained. RAY and WILLUGHBY had, we find, got so far as to establish, practically speaking, the notion attaching in science to the word species, and had even come to the point of proposing a kind of systematisation, though the system they put forward is full of faults and is not at all consistently applied; only to mention one unsatisfactory point, it is based on a series of subdivisions so defined that they are not mutually exclusive, one of the other. Nevertheless the work marks a distinct advance, among other things by the fact that the descriptions it gives of fishes are quite detailed and satisfactory. One of the most noticeable faults in WILLUGHBY'S work was the total lack of any definite and precise nomenclature. Thus, the very groups or subdivisions in which the fishes were classed had no exact names, being merely described in long sentences.

Consequently, in spite of all the work that had been done before his day, both in the domain of Ichthyology and in Zoology as a whole, ARTEDI found a very chaotic state of things prevailing when he began to study. As a contribution towards remedying that, is to be regarded the second section of his great work, entitled "Philosophia Ichthyologica", for it is concerned with introducing order and clearness into the classification of the various objects with which natural science deals, in place of the confusion and muddle that marked the works of his predecessors. In this section ARTEDI gives plain and distinct definitions of the various notions the

science of Ichthyology embraces, and when describing the various parts, both internal and external, of the body of a fish, as regards shape, appearance, function etc., he establishes a terminology for application to other similar descriptions in the future. Having thus introductoryly pointed out what characteristic features in animals, more especially fishes, ought to be studied by the ichthyologist, — in doing which he finds occasion to remark that the blood-vessels, the lymphatic ducts and the nerves may be passed over, as being too special and as more properly belonging to the domain of Comparative Anatomy — he goes on to make clear for what purpose the knowledge in question should be acquired, that being to enable us to arrange and subdivide fishes systematically.

Now it is not only in Ichthyology that certain genera show points of agreement with one another; the same holds good in all branches of natural history. Thus, to take an example, the clawed mammals all resemble each other, and the same is true of those that are hoofed; if, however, a clawed genus be compared with a hoofed, they will be found to differ in most particulars. This shows that it is possible to arrange animals for scientific purposes in main divisions or classes, and likewise plants, &c. These classes may be either artificial, or hypothetical, or natural and true divisions, depending upon what ground of classification is chosen. It is one of ARTEDI'S great claims to be remembered with honour, that he was the first to advocate natural classes, and to show how utterly unscientific it was to choose as the ground of classification, as had been done in ichthyological treatises before his time, either the habitat¹ of the animals, their size, etc., or the number of their external organs (e. g. fins). The instance of fins will probably have been adduced as a criticism of WILLUGHBY'S work, for he employed the

¹ However astonishing it may seem, there really existed at one time a quasi-scientific classification of fishes into: Sea-fishes, River-fishes, Lake-fishes and Marsh-fishes (by RONDELETIUS).

number of fins to some extent as a ground of classification. ARTEDI went on to make his point clear as to the absurdity of such a classification by showing that certain fish, such as cod, mackerel, perch etc., which are closely allied to one another, have a differing number of fins. We may very forcibly have brought home to us how far ARTEDI in this matter was ahead of his age, if we recall to mind the fact, that more than 60 years later two Germans, M. E. BLOCH and J. G. SCHNEIDER, who were considered at their time exceedingly distinguished ichthyologists, promulgated a new system of classifying Fishes on the very basis repudiated here by ARTEDI; they proposed as classes: — “Hendecapterygii”, “Decapterygii”, “Enncapterygii”, etc.

Natural classes ARTEDI defines to be such as embrace genera possessing a natural agreement in most particulars. Hence the genera should first be grouped correctly and naturally among themselves and be collected into certain “Maniples”, as he calls them, after which the several classes can be arranged. According to ARTEDI Fishes form together one class, which is parallel to a class of Mammals, a class of Birds, etc., etc. Consequently subdivisions of these classes must have some other designation than Classes; he suggests Orders.

What is known in more modern systematology as a Family does not find a place in either ARTEDI'S or LINNÆUS' nomenclature, though the former seems to be on its track, for he doubtless means the same thing by his Maniples; the following sentence in his writings points still more clearly to his being aware of the need for such a further division: — “Genera Piscium Naturalia prius in certos quasi Manipulos conquærenda sunt, ex quibus postea Ordines Naturales sponte exsurgunt”. That is to say, ARTEDI perceived that, after the natural genera of fishes have been collected into small groups (his Maniples, the Families of a later date), the arrangement of these in natural Orders would follow almost as a matter of course. In his subsequent treatment of

the subject he remarks that it is of little moment whether the Orders be few in number or not, but that one advantage will accrue from their being few, in that the difficulties of drawing the natural boundary-lines between the Genera vary directly with the number of the Orders.

It was in very truth a great step forwards in the development of science that ARTEDI had herewith taken. Fully grasping the state of confusion that prevailed in natural history systematics and nomenclature as he found them, he made bold to urge the necessity of a thoroughly systematic classification, demanding at one and the same time "classes naturales", "ordines naturales", and "manipulos naturales"; this he did, it is true, primarily for fishes, because his whole work deals with them, but, as pointed out above, he repeatedly asserts that the same thing holds good "etiam in reliqua Historia naturali". He goes, indeed, still further, for he also desires to obtain "genera naturalia"; the correct determination of these, moreover, he seems to have regarded as of the utmost importance, speaking of it as the chief aim and object of the whole science of Ichthyology.

The discussion that ARTEDI then proceeds to enter into as to what is to be understood by Genus, was by no means out of place at the time he was writing, for the genus-notion, though not wholly unknown, had never been clearly grasped or defined. ARTEDI says about it: — "Genus in Historia naturali est Analogia quædam Specierum certarum, quæ in Figura, Situ, Numero vel Proportione Partium ita conveniunt, ut ab omnibus aliorum generum speciebus in aliqua minimum parte differant." This definition, which has general application in Natural History as a whole, is followed by one specially adapted to Ichthyology:¹ "Genus Ichthyologiæ est convenientia quædam certarum specierum, seu simili-

¹ There exists a certain similarity in wording between this definition and that given in § 167 of LINNÆUS' "Fundamenta Botanica"; hence L., in editing A.'s work, added a reference to his own.

tudo quorundam Piscium ad speciem diversorum, qui in situ Partium externarum *semper*, numero *plerumque*, Figura et Proportione sæpe conveniunt." The genera are recognisable by certain characters, which are of such a nature that, by their aid, "the various fishes belonging to different genera can be told apart and be referred to their respective genera".

As ARTEDI, both here and in several other places in his writings, makes a point of the universal applicability of the general statements which he enunciates regarding Fishes, with which he is directly concerned, we are justified in looking upon his reform work as of the utmost import for the whole systematics of Zoology. For instance, he remarks, with reference to genus-characters, that natural characters constitute "primum et præcipuum Fundamentum non solum Ichthyologiæ sed totius reliquæ Historiæ naturalis", and similar extracts might be multiplied.

With regard to the characters to be made use of in delimiting the various genera, ARTEDI points out how essential it is that they should be chosen judiciously, for otherwise the classification will be of no practical use from a scientific point of view; thus, the general outward appearance is apt to be seriously misleading, as the example of the tench and the lake-trout plainly proves, for though they resemble one another fairly closely in external shape of body, yet one of them belongs to the carp-genus and the other to the salmon-genus. He also calls attention to the fact that the same characters may have different systematic values in different groups, and that as a consequence it will not by any means always be feasible to employ the same kind of characters as distinguishing marks for congeners in different orders; he illustrates his argument by adducing examples.

The next question taken up for discussion is which properties of fishes lend themselves for employment as genus-characters, and which do not. ARTEDI considers that the best and most constant genus-character for os-

seous fishes is to be looked for in the number of the branchiostegals of the gill-membrane, though regard must also be paid to the general appearance, the position and number of the fins, the place of the teeth, the shape of the scales, and other external features, nor should the importance in this regard of certain internal anatomical characters be lost sight of, such as the stomach, the caecal appendages of the pylorus, the intestines, the bladder, etc.

By following the rules laid down by ARTEDI and their corollaries, the scientists who came after him were able to differentiate the genera of fishes one from another. In order, however, that the notion of genus might have accorded to it the full value it deserved, it was necessary, as ARTEDI clearly perceived, to establish certain definite genus-designations. This was a complete novelty, and one of the utmost significance. Previous to his time nothing of the sort had been conceived, which is of course not to be wondered at, seeing that the very notion of genus had not as yet become an integral part of the zoologist's system of classification. Up to that time it had been usual to identify any particular fish by citing a long list of synonyms, accompanied by a more or less lengthy series of descriptive epithets.¹ Now, on the other hand, it is ordained that to every genus a name shall be given consisting of one word only, whereby all the species belonging under that genus shall be known and distinguished. Furthermore, the rules of nomenclature are also stated, in order that the new system may be the more firmly established.

There was every reason for ARTEDI to adopt radical measures for imposing his reforms upon ichthyologists; the names used at his day presented a picture of incredible confusion and muddle; for fishes belonging to

¹ As a typical example may be here cited the notation given for cod by WILLUGHBY and RAY in the work quoted above: "Asellus major vulgaris, Belgis Cabiliau, Mohrua vulgaris (maxima Asellorum species) Bellon. Molva vel Morhua altera minori Rondel. Gesn. p. 102 Aldrov. lib. 3 Cap. 6. A. Cod-fish, or Keeling".

his carp-genus (*Cyprinus*) there were no less than 25 different names in use, for his herring-genus (*Clupea*) 14, and so on. Since his day, it is true, these genera have been subdivided, but at the time it was essential to collect and combine the forms in groups, for the purpose of obtaining appropriate unity and clear arrangement; all the more so, as some of the names in use had been promiscuously allotted to fishes of the most widely differing genera.

Another practice of his predecessors that ARTEDI severely condemned was the using of one name to designate several different animals. To give some examples: *Canis* and *Vulpes* had been employed, not only for dog and fox, but also for shark; while the shark, which was thus sometimes called *Vulpes*, was at other times named *Simia*, ape. *Lepus*, hare, signified sometimes also lump-fish; for the gurnard, of the *Trigla* genus, the bird-names *Corvus*, raven, *Hirundo*, swallow, *Cuculus*, cuckoo, *Milvus*, kite, *Accipiter*, hawk, &c. had to do duty; *Passer*, sparrow, was also a name for the flounder, while *Rana*, frog, was applied likewise to the fishing-frog or devil-fish.¹ A more complete confusion is scarcely to be imagined, but at one stroke it was swept away and order and consistency were established in its place.

In the choice of names ARTEDI was throughout very strict; he rejected all such as were employed at the same time for plants or other familiar objects, household utensils and so on; he only approved, indeed, names of Latin or Greek origin, while even of those he refused to recognise diminutive formations and derivatives in *-ides*, and could not sanction the use of substantivised adjectives or forms latinised in modern times and not found in the works of standard authors; he objected, too, to such names as denote place of origin, like *Sardina* from Sardinia, *Sturio* from Asturia, &c.

¹ Among other names employed to designate fishes may be here added the following: — *Elephas*, elephant, *Mustela*, marten, *Vespertilio*, bat, *Alauda*, lark, *Aquila*, eagle, *Larus*, sea-mew, *Pavo*, peacock, *Scopanax*, woodcock, *Turdus*, thrush, *Gryllus*, cricket, &c., &c.

In conclusion he gives a list of names which he considers satisfactory and permissible.

Some of these stringent rules have been modified by later usage; others, again, have been ratified by the authoritative verdict of international conferences even down to as recently as the close of last century. That fact is testimony sufficient to the excellence of the suggestions which the youthful Swedish scientist, on his own initiative and without any forerunner to guide him, thus evolved and placed on record for the benefit of those who were to come after him. Some of ARTEDI's above-mentioned rules of nomenclature bear considerable resemblance to similar suggestions made by LINNÆUS in his "Fundamenta Botanica", — to which circumstance reference will be made below.

After having dealt at length with Genera and generic names, ARTEDI next turns his attention to lesser units, Species and Varieties. "In Ichthyology", he says, "every fish constitutes a Species which differs from other forms in the same genus in regard to some outward features, owing to something material being absent or present either as regards number, proportion or shape, or owing to some constant difference in colour". The points of distinction, however, between the various species may vary very considerably in kind and degree. The definition given is then illustrated by a series of examples which are critically discussed, occasion being thereby found to call attention to the need for caution as regards attaching weight to colour as a distinguishing mark, since the colour is apt to vary even in the same form.¹ One species-character that he recommends as reliable, is the number of spinal vertebrae in osseous fishes, but as care must be exercised in employing this test too, he proceeds to enjoin certain rules concerning it. As it not infrequently occurs that errors are made

¹ In connection with this point, ARTEDI complains about the difficulty of settling the compass and scope of the various species belonging to the salmon-genus, a complaint which numerous ichthyologists since his day have undoubtedly felt ready to share.

in diagnosing forms, whereby species have been thought to be distinct which are really alike, owing for instance to a misapprehension of a minor variation either in colour (due merely to differing degrees of intensity), in size, in habitat (e. g. lake and marine perch), or in spawning-time, etc., he lays special stress on the need for accuracy and discrimination; such slight variations do not give rise to the establishing of new Species, but only to "Varieties".

Just as ARTEDI, after defining what was to be understood by genus, subjected genus-names to a severe scrutiny, so now, when he has discussed species in general, he goes on to examine critically the names in use for them. "A species-name", he says, "is the epithet, consisting of some few words, which is appended to the genus-name, in order to distinguish one fish species from the others in the same genus". These epithets must be effective for the function they are thus required to perform; if they only state the more or less general occurrence of the species, its assumed sequence in the genus, home, mode of occurrence, size, varying colour or markings, etc., they are, as being of no use to the reader, spurious and repudiable. Genuine species-names, on the other hand, are those which serve to mark off at a glance, or with a minimum of effort, one species from the others in the same genus. They must, in other words, state such genuine species-characters as have been mentioned in the foregoing.

In having solved the question of genus-names so excellently, by enunciating such clear and definite rules for their use, ARTEDI was on the very threshold of a complete solution of the nomenclature problem; there would seem to have been but one simple step for him to take, to arrive at the law of binomenclature; however, in treating species-names he drifted away from the right track, owing to the exacting demands he made upon them. Genus-designations, or generic names, he transformed into real names, but in dealing with species names he confused the two ideas of name and diagnosis;

in demanding of species-designations that they should express the differences existing among the several species, it was no longer possible for him to insist on unity in a species-name which was to fulfil those conditions, and still less possible as time went on and more and more forms became known and had to be scientifically treated. Consequently it was reserved for LINNÆUS, 20 years later, to publish to the world the System of Binomenclature, and so to arrive at the final solution of the problem of how successfully to name natural history objects. The foundation laid by ARTEDI should not, however, on that account be forgotten or discredited.

In several places in ARTEDI'S "Philosophia" there are to be found references to the "Fundamenta Botanica" by LINNÆUS. These references must of course be due to the editor's hand, for ARTEDI had died before LINNÆUS' work appeared. Moreover, quite apart from these references, there are some very marked points of contact in the two works, for instance with regard to the nomenclature rules laid down by each for his special science. AS LINNÆUS edited both works, one might be tempted to draw a conclusion to the effect that it was he who inserted in ARTEDI'S work the rules in question, so as to bring it into harmony with his own. The erroneousness of any such conclusion can, however, be clearly and incontestably demonstrated by definite statements of both the authors concerned; those statements fully deserve to be quoted here, since it is of the utmost interest to establish, if possible, to whom the honour accrues of having done Science the inestimable service of effecting the systematisation of its nomenclature. When LINNÆUS went to Amsterdam, shortly before ARTEDI'S death, to see and consult with his friend, the latter, as we saw above, read aloud to him the whole of his "Philosophia Ichthyologiæ". From that fact, narrated by LINNÆUS, we may undoubtedly conclude that the manuscript was then complete. LINNÆUS also tells us that among ARTEDI'S effects he found the manuscript of the "Philosophia" entire; that would seem to settle

definitely the question of ARTEDI'S sole authorship, but it is still more clearly proved by what ARTEDI himself wrote in the Preface he indited in London, that is to say before he met LINNÆUS in Leyden. We find there that ARTEDI gives a brief account of what his work is to contain, and writes in one place as follows: --- "I then remarked that no ichthyologist had up to that time ever differentiated Genera clearly, nor described their characters, nor marked off Species"; he then goes on to relate that he has been at very great pains to examine fishes throughout their structure, for the purpose of detecting the methods by which generic characters and the very genera themselves had arisen, "and that the impartial reader can convince himself of in the 'Philosophia'". "I saw, furthermore", he says, "that most of the generic names were not of Latin, but of base origin, and I have purged Ichthyology of those barbarisms". He mentions, too, having discarded such generic names of fishes as were also used in other departments of the animal world, in order to banish all cause of confusion, and relates that he has explained the distinction between real Species and mere Varieties, and that he has pointed out what specific names are spurious and what genuine, etc. In a word, he states briefly but completely what the contents of each part of his work are, and by so doing has placed it upon record beyond gainsaying that the work proceeded from his own brain and is not in part the production of another. On the other hand, it is in like manner incredible that LINNÆUS should have borrowed any of his theses from the manuscript of his friend, for the "Fundamenta Botanica" was in a finished state when the meeting of the two friends in Amsterdam took place, and was probably already printed by the time CLIFFORD had redeemed ARTEDI'S manuscripts. How are we then to explain to ourselves the remarkable degree of harmony subsisting between the fundamental rules laid down by the two investigators? It is doubtless wholly due to the agreement in their respective acceptations of science and scientific

phenomena, which found expression naturally enough in a similarity of result when they came, independently of each other, to treat their respective branches of knowledge. That fundamental agreement in outlook, again, took its rise, it is safe to presume, in the days when they enjoyed constant access to each other, and freely and thoroughly discussed all the topics and problems that presented themselves to one or other of them; it was the legitimate fruit, in short, of their loyal and assiduous cooperation in the laborious pursuit of learning when undergraduates together in Upsala. Already at that period, we may confidently suppose, they had each evolved and framed a system of treatment for the science he was more especially interested in, those two systems being, however, by reason of their originators' community of thought and experience, to all intents and purposes, one and the same. At this length of time it is quite out of the question for us to apportion to each of the two brother investigators his due and rightful share in the joint result; we can but at the best venture a rough conjecture on the basis of those differences in their temperaments which have been depicted in the foregoing pages. In some particulars, it is true, a divergence of view makes its appearance, the most conspicuous perhaps being, that, in reference to the arrangement of Classes and Orders, ARTEDI insists over and over again on the necessity of them being natural in origin, whereas LINNÆUS allows other considerations to have some deciding weight in the matter; as far as that goes, the former is ahead of, or more modern than the latter. Even in his Preface ARTEDI says, "... before everything I have urged that the Orders should by all means be natural" — — "but such Orders ought not to be admitted as separate closely allied fishes one from another and combine together those that are not related — — —". LINNÆUS, on the other hand, writes that, *cæteris paribus*, natural Orders are superior to artificial ones, but adds resignedly that the Classes depend upon the agreement of the Genera in certain respects,

“secundum principia Naturæ et Artis”, and states in another place that “classis ac ordo” are the work “Naturæ et Artis”. Both of the writers, however, were perfectly convinced that some definite system was an indispensable requisite, a “filum ariadneum — — — sine quo chaos”, and to both of them belongs the honour of having, each in his own department of science, established that essential system.

The three remaining parts of ARTEDI’s “Ichthyologia” constitute, as LINNÆUS remarks in the Introduction, the practical application of the theories put forward in what preceded. The first of them is entitled “Genera Piscium”, and contains a presentment of the System of Fishes as it was conceived by ARTEDI. The Class of Fishes he divided into 5 Orders, one of which, however, the “*Plagiuri* (with horizontal caudal fin)”, embraced the whales. Though ARTEDI on several occasions pointed out that whales in many particulars resembled Mammals, he did not seem able, any more than his predecessors, to decide upon excluding them from the class of Fishes. It was not until LINNÆUS published the tenth edition of his “Systema Naturæ”, 20 years later, that they were once for all banished from the Class to which they have no just claim to belong. The other four Orders in ARTEDI’S System are: — *Malacopterygii*, the soft-rayed fishes, *Acanthopterygii*, the spiny-rayed osseous fishes, *Branchiostegii*, osseous fishes but lacking bones in the gills, and *Chondropterygii*, real cartilaginous fishes, embracing also sturgeons and lampreys. This classification is marred by numerous shortcomings, as was only to be expected considering it was a first attempt. When sturgeons and lampreys, however, are removed from the last-named Order, the *Chondropterygians* form a unitary conception, and they still go under the same name to this day. The *Branchiostegals*, on the other hand, formed an entirely artificial group, and were soon disintegrated as such, the several members being relegated to other places in later Systems. The remaining two, again, the *Acanthopterygians* and the *Malacoptery-*

gians, maintained their ground for a long period with hardly any modification. By degrees, however, they were subdivided, as the knowledge of the science increased and numerous new forms were discovered. Nevertheless, as late as the year 1904, one of the most eminent of living ichthyologists, partly no doubt out of piety, has made use of the designation *Malacopterygians* for a Sub-order of osseous fishes containing a nucleus of those fishes ARTEDI placed in the Order of the same name, e. g. herrings and salmon. The above-mentioned author, has, furthermore, employed the name *Acanthopterygians* for a Sub-order, which in addition to a number of new forms of later discovery, contains all the genera that ARTEDI classified under his Order of that name, with the exception only of two, the mullet and stickleback genera.

Among these four Orders of Fishes ARTEDI distributes 45 Genera, which he also defines, shortly indeed in general, but at the same time clearly and distinctly. On the whole, these Genera, as classified by ARTEDI, fulfil the demands he laid down for naturalness, for, although most of them have suffered subdivision into two or more new genera, owing to the great strides Ichthyology has made since that time, they nevertheless then represented natural groups of forms bearing affinity one to another. Hence it must be acknowledged that ARTEDI'S System of Fishes proved in practice to be of sound scientific conception; here and in the following section of his work opportunity was afforded him of putting into application the rules which he had drawn up for nomenclature, etc.

The fourth part of ARTEDI'S "Ichthyologia" is called "Synonymia Nomium Piscium". In it, as GÜNTHER truly remarks, references to all previous authors are arranged for every species, very much in the same manner as is adopted in the systematic works of the present day; these references and quotations are inserted under the diagnosis of each several species, entailing for the author a vast amount of labour, as LINNÆUS had occasion to

find out when editing the work, for ARTEDI had not quite finished off the copying of them in. The laboriousness of the task becomes patent to all, when it is known that ARTEDI was so conscientious that he went back even to the ancient Greek and Latin writers, and endeavoured to elucidate what they may have meant by their varied and diverse nomenclature and by other statements concerning certain fishes. More than 150 forms have been dealt with in that thorough-going style, the quotations under each one often exceeding a score in number. ARTEDI'S "Synonymia", consequently, bears witness in its author not only to an exceptional capacity for arduous toil and a deep and wide reading, but also to a rare degree of critical acumen and exactitude. For that reason the work forms a practically indispensable key to the earliest ichthyological literature.

The fifth and last section of the "Ichthyologia" bears the title "Descriptiones Specierum Piscium quos vivos præsertim dissecuit et examinavit". Of this section LINNÆUS writes in his Introduction to it as follows: — "You would, indeed, have been amazed, courteous Reader, could you have watched with what persistency, with what never wearying toil, the author of this work proceeded about his self-imposed task of describing his fishes, spending in many cases several whole days over one single fish. Had you been in that fortunate position, you would have been witness to the wonderfully adroit way in which he would count over the fins, and the individual rays in them, not once only but many times, and to the method he had of enumerating and giving an account of all and each of the dorsal vertebræ — — —". LINNÆUS also informs us that the material examined for the purpose of ARTEDI'S descriptions was derived in part from Lake Mälaren, in part from Norrland waters and the North Sea, and in part also from the seas off the English coasts and out of the museums to which he obtained access. Altogether there were 72 forms which he found opportunity to examine and accurately to describe. He was not con-

tent merely to study the outward appearance of the fish; as the title tells us, he also dissected every specimen and he gives a full and exact account of the shape and position, etc. of the inner organs and parts. Hence GÜNTHER, the renowned ichthyologist, might well say, in 1880, of the contents of this section, "descriptions which even now are models of exactitude and method".

From this part of his work, as from his depiction of "partes piscium" in his "Philosophia Ichthyologica", we can very plainly perceive that ARTEDI was exceedingly well versed in the Anatomy of Fishes, as is abundantly evident, for instance, from the exhaustive description he gives in that place of the system of blood-vessels in fishes, which for that time is quite marvellous. ARTEDI's knowledge of that subject enabled him to demonstrate the anatomical differences found to exist in fishes when they are compared one with another, and to call attention to the importance of that phenomenon for the scientist who is about to determine the classification of the fishes according to natural principles; in that respect ARTEDI may be looked upon as a harbinger of that method of investigation, which was to attain full maturity long afterwards under G. CUVIER, JOHANNES MÜLLER and others, the method namely of Comparative Anatomy.

Beyond the important work above briefly reviewed, we only possess by ARTEDI's hand some descriptions of fishes in the third volume of "Sebæ Thesaurus", the large illustrated work giving a report upon the natural history collections of SEBA, the Dutch chemist. It contains 12 folio plates, some of them being double, with 140 reproductions of fishes together with descriptions of them. Which, or how many, of these ARTEDI is respons-

¹ According to LINNÆUS' own note, there were only 6 fishes left undescribed.

² About ARTEDI's "Philosophia Ichthyologica" GÜNTHER says, in his "Introduction to the Study of Fishes" (p. 10): — "in fact he establishes the method and principles which have subsequently guided every systematic ichthyologist".

ible for we do not know. The only information we have is, that he had nearly completed his work for SEBA when he met with his death. The Introduction contains the following passage: — “That portion of the work dealing with Fishes should prove the more welcome to students of Fishes, as we have to thank ARTEDI, “celeberrimo illi piscium Scrutatori”, for them — though not for all. That chief among ichthyologists had almost accomplished the whole description of the collection of fishes in SEBA’S Museum, when his life was brought to an untimely end”. The accuracy noticeable in the descriptions betrays the hand of a past master in the art; we cannot but regret, however, that his life was not spared long enough to enable him to incorporate in his System the experience which the labour with SEBA’S collections undoubtedly afforded him. While studying them, he came across new Genera and a number of Varieties, so that his knowledge of Fishes was materially increased; his limited time did not, however, always allow of his giving to his descriptions the due form, which he himself prescribed in the rules he laid down in his “Ichthyologia”. Nor did he find opportunity to systematize SEBA’S fishes, much less to draw any conclusions from them. Consequently the value of this last work of ARTEDI’S is confined to his having correctly diagnosed certain fish-forms and named some genera. Among the latter may be noticed Anableps or the telescope fish, whose curious visual apparatus was dissected and may be seen depicted in the work.

The brief survey attempted in the preceding pages of the scientific work accomplished by PETER ARTEDI in the department of Zoology, and more especially in that of Ichthyology, is now complete. From it the conclusion may easily be drawn that zoological research was directed by his instrumentality into new paths which were destined to carry it forward to ever increasing success and development. ARTEDI was the first to settle definitely the notion of Genus in Zoology, to make clear the distinction existing between Species and Variety, to

demand a classification on natural principles into Classes, Orders etc., based inter alia on comparative anatomical investigation; in so doing he laid the foundation of a scientific System pure and simple. Further, he reformed the system of naming then in vogue, by laying down strict and definite nomenclature rules for future use. In all this work he was a pioneer, and he had found time before reaching the age of 30 to devise and work out the principles of a new science, when the sad accident occurred by which his life's thread was severed. It is futile to wonder what he might have accomplished for Science had he lived to complete life's normal span; what he did achieve in his brief day was great and wonderful. Hence it is with pride that his fellow-countrymen of the present day may remember that he signed himself, "PETRUS ARTEDI *Svecus*", this "Ichthyologorum longe Princeps", who was thus carried off in the flower of his age, and that he was a true son of, and an honour and an ornament to the land of his birth. It is not more than fitting that a simple tribute of homage be herewith paid, on the occasion of the 200th anniversary of his birth, to one whose name will ever constitute a fair and glorious memory in the annals of scientific research in Sweden.



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